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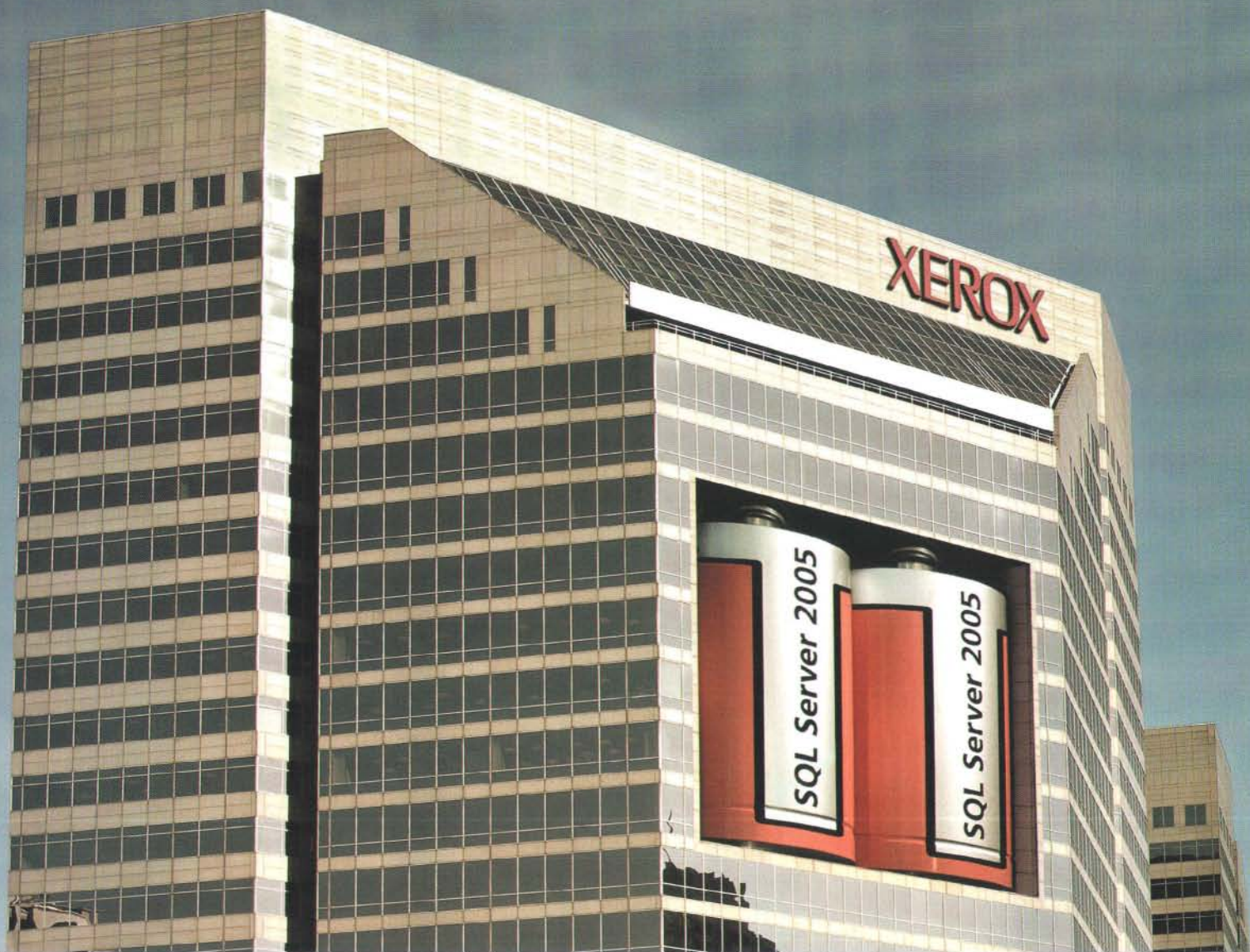
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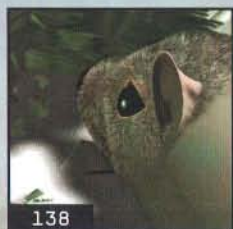
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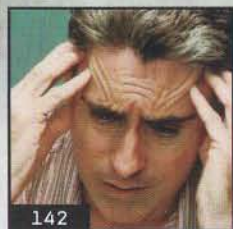
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The Nissan Pathfinder



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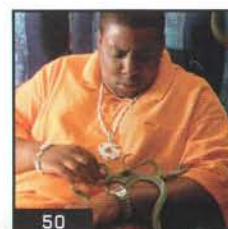
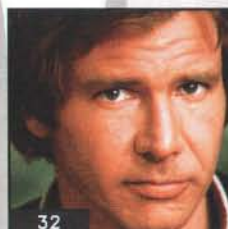
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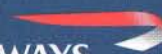
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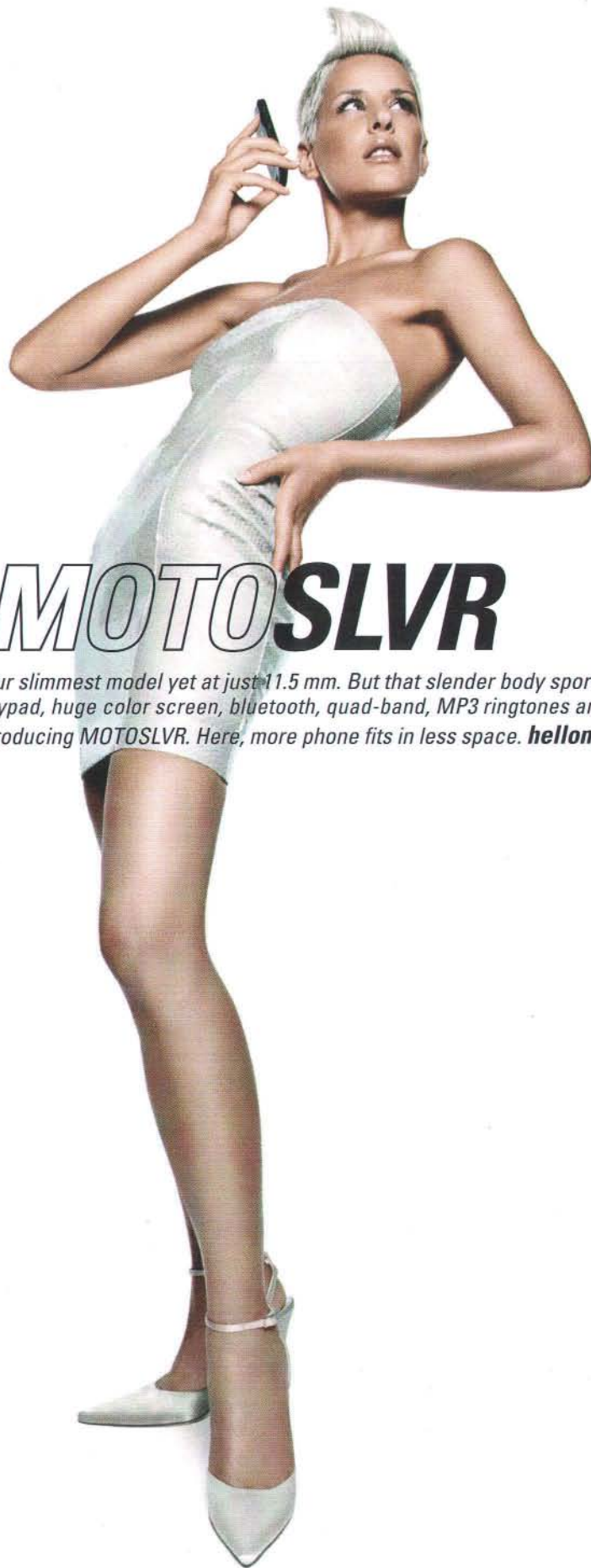
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"People like Carsten have found the secret to happiness," **BOB PARKS** says of amateur submarine builder Carsten Standfuss (page 31). "They look for a challenging project and they let it consume them." The longtime *Wired* contributor is an authority on recreational engineers. He interviewed more than 100 to research his book *Makers: All Kinds of People Making Amazing Things in Their Backyard, Basement, and Garage*.



ERYN BROWN has seen the future of blogging—it's Jason Calacanis, who recently sold Weblogs, Inc. to America Online for a reported \$25 million (page 116). "That's no small potatoes, especially for a firm without official office space," says Brown, a former senior writer at *Fortune*. "It'll be interesting to see if other entrepreneurs figure out a way to make blogs self-sustaining or if they do what Jason did: join forces with an Internet biggie."



As part of our annual *Wired Home* guide, **TOM VANDERBILT** profiles design visionary Michelle Kaufmann. Her high-end, next-gen Glidehouse is changing the reputation of factory-built houses (page 82). "Many architects draft up a prefab project as an intellectual exercise," says Vanderbilt, who also writes for *Popular Science*. "But she has a growing roster of clients; her passion is really paying off."






Not long after his failed attempt to become a sumo wrestler (an experience chronicled in his new book, *The Underdog: How I Survived the World's Most Outlandish Competitions*), contributing editor **JOSHUA DAVIS** was assigned to profile Sebastian Thrun, whose robot car won the Grand Challenge, Darpa's 132-mile off-road race (page 130). "Contests push us," Davis says. "And sometimes, the results are mind-bending."

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RANTS + RAVES

"IT'S A MUSIC LABEL'S JOB TO SEEK NEW REVENUE OPPORTUNITIES!"



Write a tough story about Apple and the Macolutes will attack. We learned as much from our November issue, in which we dinged the ROKR handset from Apple, Motorola, and Cingular. "Apple doesn't call this the phone of the future," ranted one loyalist. "Blaming Apple for this crappy phone is just pedestrian Apple bashing at its worst." Hey, when Steve Jobs trots out something on a giant vide screen, it's fair game. Other grumps took issue with a quote we attributed to Mark Twain: "Everybody talks about the weather, but nobody does anything about it." Wrote one aspiring fact-checker, "This remark was actually made by his neighbor and good friend Charles Dudley Warner." Actually, Warner did say it, but it's believed he was merely quoting his pal Twain. Now, about that cold winter he spent one summer in San Francisco ...

Celling Their Souls

Kudos on Frank Rose's article about the ROKR ("Battle for the Soul of the MP3 Phone," issue 13.11). It ought to be required reading for cellular carriers, handset makers, music executives, and especially Steve Jobs.

I carry around a Creative Zen Xtra player (I refuse to buy into Apple's digital rights management and pricing) and a Samsung phone. I'd love to have a single device that doesn't compromise on either feature set, but it's clear that the industry isn't ready to make the kind of concessions that would allow this. Maybe the powers that be will get a clue one of these days.

Michael Salsbury
Hilliard, Ohio

Rose criticizes the music labels for "blindly grasp[ing] for short-term gain" by seeking a premium price for music available for impulse download to mobile phones. But it's the music labels' job to seek new revenue opportunities; we can hardly fault them for doing so. In an open and free marketplace, consumers will ultimately settle the matter of a fair price for music. Relying entirely on "focus groups" as an indicator of future consumer price acceptance, as two of Rose's sources apparently do, is a foolish mistake. After all, prior to the arrival of Starbucks, who would have said they would one day happily pay \$2.50 for a cup of coffee?

Catherine Lundquist
Venice, California

You're wrong that "you'll have to run up data charges on Verizon's network" to get songs on a Verizon phone. I put 110 songs and an hour-long podcast on a TransFlash card and inserted it into my Samsung phone for free. It also answers calls during MP3 playback. Sorry, Mr. Jobs, you can keep your ROKR.

Dennis Kreitzburg
Northfield, Ohio

Wow, so cellular providers and Apple don't put consumers first? Tell us something we don't already know! You would better serve your readers by investigating alternatives. What are the best Palm, Java, and Symbian mobile apps for playing multimedia on phones and transferring playlists to them? What phones are best at running those apps, pausing playback for incoming calls, accessing media files, and using MP3s as ring tones? Few consumers know enough to demand these features, so phone software and hardware makers don't have to compete on them.

S. Page
San Francisco, California

Music to Our Ears

Thank you for Michael Chorost's thoughtful, brilliant account of how he regained his hearing ("My Bionic Quest for *Boléro*," issue 13.11). I lost 80 percent of my hearing for five years of my childhood, and I can relate to Chorost's love of *Boléro*. In 1972, my obsession was the soundtrack to *A Clockwork Orange*.

I regained 100 percent of my hearing, spent five years in speech therapy, and still treasure my musical experiences. I congratulate Chorost on this breakthrough and hope he'll continue assisting the researchers.

John Thorton
Austin, Texas

Michael Chorost's story was simply amazing. Someone should compose a piece that warps *Boléro* to illustrate the auditory progression Chorost endured.

Thron Crowe
Sanford, Florida

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RANTS + RAVES



"Eyeball overload," by Nick Spark.

Bottoms Up!

Brian Ashcraft's article "The Mystery of the Green Menace" (issue 13.11) was fascinating. Here's hoping the US legalizes absinthe soon.

Eric Doise
Gainesville, Florida

The XXX Threat

Pornography is a pox on humanity ("Skin City," issue 13.11). Sadly, *Wired*'s willingness to cover the adult video service WantedList as "news" (anything for more subscribers) only serves to feed this debasing disease. The quicker WantedList goes under, the better.

Steve Morsa
Thousand Oaks, California

Open Source of Frustration

Mozilla's Mitchell Baker could work at Microsoft with answers like those quoted in "Is Firefox Insecure?" (Start, Hot Seat, issue 13.11). There's no way to measure Firefox's security vulnerabilities yet, but she's sure a count of security holes is wrong? If the open source approach can't identify existing apps' security shortfalls, why should I trust that software?

When smoke starts pouring from my PC, I don't care how much time the open source community has spent discussing the cause of the meltdown. Fix the damn problem, people, or you're no different from a regular company, just less accountable.

Jim Herries
Redlands, California

Literary Criticism

In "Google's Tough Call" (Posts, Lessig, issue 13.11), Lawrence Lessig trots out the favorite analogy of the anti-copyright crowd: "Imagine if a library needed consent to create a card catalog." But a standard library card catalog contains information only about the book (author, title, place and date of publication, format, size,

subject headings). It does not contain the book's text. Computerized library indexes do sometimes contain text from the books, and most of those excerpts are provided by services that get permission from publishers and authors.

Google Print would be wonderful if its database was produced with the cooperation of authors and publishers. Lessig doesn't appear to understand the reality of the situation.

Sean P. Fodera
Brooklyn, New York

I've been an avid fan of *Wired* since near its inception and probably always will be. But Lawrence Lessig's article brought up an issue that's been bothering me. In general, your contributors and editors openly advocate digital stealing of other people's creative materials. You have advocated stealing music and movies, and this column appears to advocate stealing books. I'm not talking about indexing or about the display of snippets of information as a way to point to the source. I'm talking about copying a whole book, a whole piece of music, a whole movie. How would you feel if someone started publishing *The Complete Wired* without your consent?

Ted Strauss
Nevada City, California

Serenity Now

When I looked at the picture for "Take Tech to Your Grave" (Start, issue 13.11), the first thing I thought of was the funeral scene near the end of Joss Whedon's movie *Serenity*. Then I read the copy ... and the device is named the Serenity Panel. Joss, call your lawyer.

Kari Summers
Cary, North Carolina

UNDO

➤ A break in the Alaska pipeline would jeopardize 850,000 barrels of oil per day, not 1 billion (Start, Atlas, issue 13.11). That quantity would affect 11 percent, not 17 percent, of US production. ➤ We misspelled the name of the artist featured in "The God of Small, Hidden Things" (Start, issue 13.11); his name is Rodolphe Gombergh. ➤ The BMW with iDrive is the 330i sedan, not the 330ci coupe pictured (Play, Motor, issue 13.11). The story also incorrectly states that Scion TC has a built-in MP3 player; it has a built-in CD player.

RANT + RAVE

Letter submissions should include writer's name, address, and daytime phone number and be sent by email to rants@wiredmag.com or by mail to Rants + Raves, *Wired*, 520 Third Street, Ste. 305, San Francisco, CA 94107. Submissions may be edited for length and clarity and may be published or used in any medium. All submissions become the property of the publication and will not be returned. *Wired* is not responsible for unsolicited artwork or manuscripts.

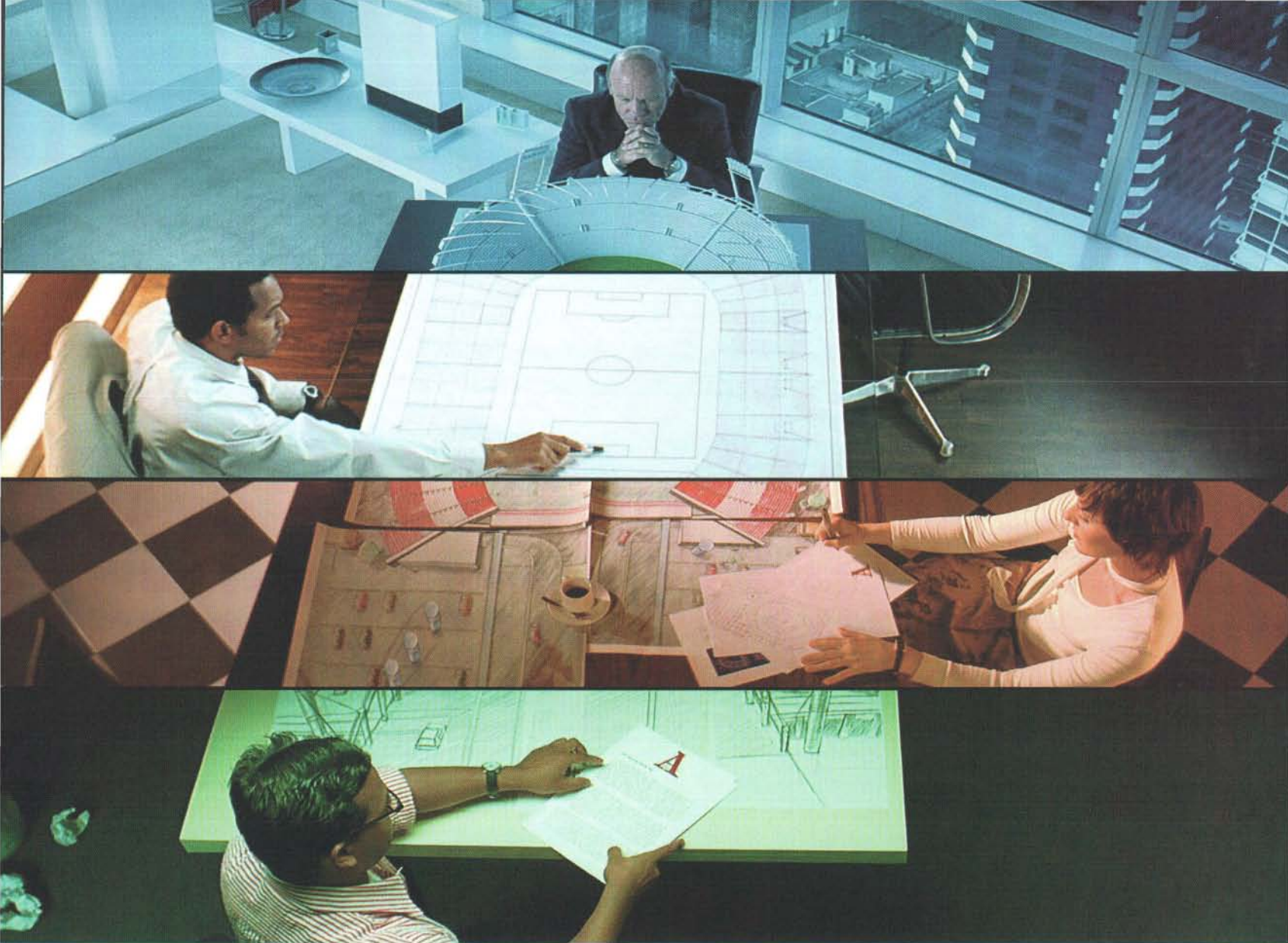
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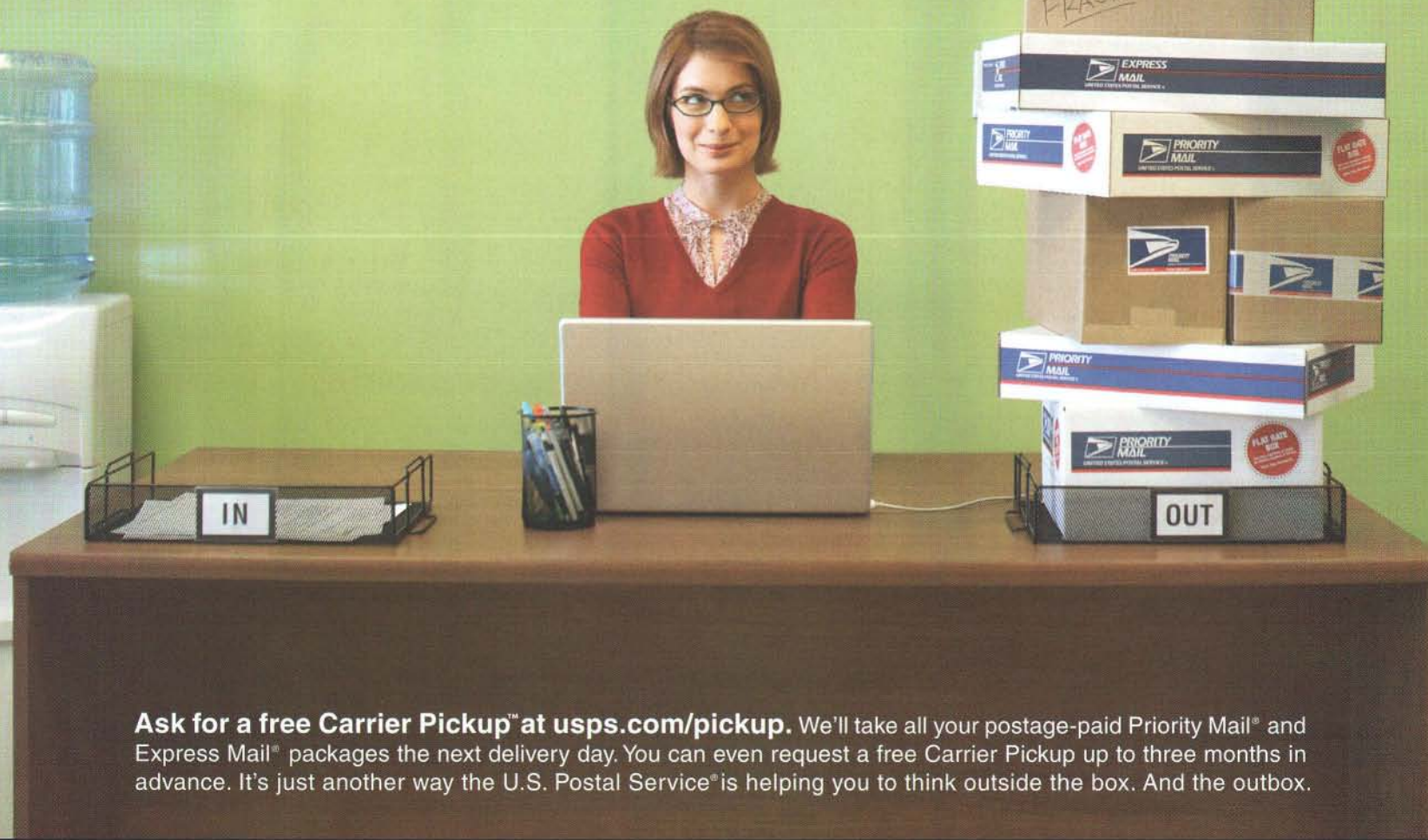
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THE ORIGIN OF SPECIES

Extraterrestrial objects plunge into the sea, releasing the seeds of life on Earth. That's the event depicted in this image, by John Brackenbury of the University of Cambridge, which recently won a Visions of Science Photographic Award in the UK. The concept isn't as outlandish as it seems. Panspermia – the notion that the basic building blocks of life float through the universe and occasionally take root in a hospitable environment – for years has been an alternative theory to how protocells formed. As beautiful as this visualization is, panspermia isn't really about eggs. Most proponents (including Nobel Prize winner Svante Arrhenius) figure that random grains of biological material from outer space set evolution into motion. But for Brackenbury, eggs embody panspermia's unconventional recipe for primordial soup. – **David Goldenberg**

Extraterrestrials by the Numbers

- Years the US Air Force ran Project Blue Book, which tracked UFO sightings: **22**
- Number of UFO sightings reported to the project: **12,618**
- Number of those objects still unidentified: **701**
- Years SETI scientists have searched for extraterrestrial life: **46**
- Confirmed ET signals detected: **0**
- Years scientists have been trying to re-create the origins of life in the lab: **53**
- Number of protocells synthesized: **0**

? ping

just one question

What technologies would we be better off without?

• Esther Dyson

Futurist, board member,
Long Now Foundation

Cell phones or VoIP on airplanes. Like so much technology, cell phones empower individuals, but they can also disempower or at best annoy other people. When used on planes, phones are a horrifying innovation that can invade one of our last bastions of silence.

• Eric Brende

Author, *Better Off: Flipping the Switch on Technology*

No technology was ever invented that doesn't have some legitimate use. Automobiles, which I try to use as little as possible, make great ambulances. Even cocaine, which I also avoid, was first devised by a doctor as a local anesthetic. Of course, there's television, the possible exception, which was probably invented to rot our brains.

• Jeff Hawkins

Developer, PalmPilot and Treo

Would I get rid of any technology for all? No. Tech is intimately linked to knowledge, and both are one-way streets. I don't like nuclear weapons. But once you know about nuclear physics, you have potential to make nuclear weapons. Whether a technology should be restricted is a separate question.



COMPLAINTS DEPT.

These Gadgets Suck!

A 3-point plan for how the industry can save itself from consumer backlash. **by Sonia Zjawinski**

Politicians and celebrities aren't the only ones serving as punch lines on *The Tonight Show* these days. "I got the video iPod," comedian Dana Carvey quipped during a recent appearance. "The new one doesn't come out till after lunch."

Yes, we gadget buyers have become the butt of the joke. Over the past five years, the golden age of gizmos has dazzled us with a flurry of shiny objects. Now we're inundated with a tidal wave of disposable products with not-so-disposable prices. We're awash in devices that look and perform alike, are on the verge of obsolescence the moment they're released, and are padded with features unfit for public consumption.

Manufacturers will likely snicker at these complaints. After all, they're coming off of another banner year in sales. But they shouldn't take our frustrations lightly – gadget fatigue will set in, and it will affect their bottom lines. Already some industry analysts are warning that 2006 may see the gadget bubble burst, with sales finally starting to wane.

The high tech gear industry could do a lot to fend off the coming backlash. I've come up with a simple three-point plan.

1. Stop drowning us in sameness. Search for "5-megapixel camera" at Amazon.com and you'll be confronted with more than 100 choices. Most are differentiated only by memory formats and mild fluctuations in price. Canon alone released six point-and-shoots from its popular PowerShot Digital Elph series in 2005 – and that's just one of

INNOVATE OR GET OFF THE POT

the company's three pocket-size digicam lines. Flooding the shelves with almost identical products just makes us feel overwhelmed. Innovate or get off the pot.

2. Stop making us feel buyer's remorse. Last year, Apple introduced the video iPod, which replaced the 30-Gbyte photo iPod, not to be confused with the regular 40-Gbyte iPod or its 60-Gbyte sister, both fourth-generation players. Did you get all that? ➔



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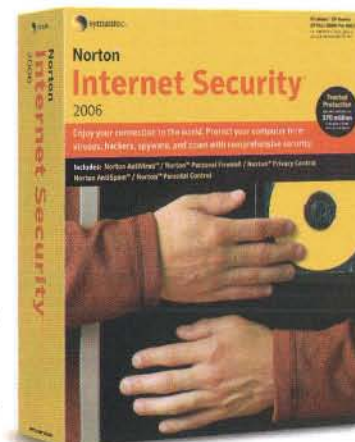
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START

← Don't forget the nano, the mini, the shuffle, and the limited-edition U2 iPod, which stayed on the company's roster for 12 months (a century in the land of Jobs). Apple has been spitting out so many versions of its ubiquitous music player that it initiated a recycling program last summer to deal with the huge turnover.

Sure, new products keep the market fresh, but it's infuriating to discover the \$300 gadget you just bought is no longer being manufactured. At the very least, companies should offer software updates (yes, you can even charge us for them!) so a player that comes with features like a color screen, large capacity, photo handling, and a speedy processor can be configured for video playback.

3. Stop releasing features that aren't ready for prime time.

At least one industry analyst says cell phone makers found that customers will pay a 10 to 25 percent premium for new features. Built-in cameras top the list. Turns out users want *decent* built-in cameras. For two years, mobile manufacturers have tried to pass off cheap lenses and imaging chips as bonuses. What we got was poor image quality, bad interfaces, and tedious procedures for getting photos off the phone.

"Camera phones were rushed to market without much understanding of what the technology was, how it was going to be used," explains Strategy Analytics' Eddie Tapiero. Has the industry learned its lesson? Music phones with limited storage, short battery life, and disappointing sales prove it has not.

The gadget industry is at a crossroads. It can either continue to turn out products that barely one-up the competition or start to make products that are of real value to consumers. While technological innovation helps move more units, only true advances that enhance performance will satisfy buyers. Consumer electronics manufacturers should focus R&D on delivering what users want: an elegant interface, durability, added utility, and style. We're sold on the big picture: We've all made the leap to a digital lifestyle. Now treat us like grown-ups. We demand smart digital tools, not expensive disposable toys.

Contributing editor Sonia Zjawinski (sonia@otodisc.com) wrote about digital graffiti in issue 13.12.

GET VERTICAL

A Skate Park Rises in the East

When Chinese officials conceived of New Jiangwan City—a "planned metropolis" on the outskirts of Shanghai—the centerpiece of downtown was supposed to be a general recreation area. Instead, clothing company SMP persuaded the government to build a 130,000-square-foot, \$26 million temple to a sport many Chinese have never heard of: skateboarding.

Convic, an Australian firm that has designed more than 300 skate parks worldwide, outfitted the facility with a full pipe, the widest vertical ramp in the world, and a center bowl so big that motorcycles can ride around in it. The firm also included plenty of beginner-level areas for newbies to practice their ollies. "The country doesn't have a real skate culture," says Aaron Wallis, a Convic designer. "But we're hoping this new park produces some amazing Chinese skaters." So, how do you say *rad* in Mandarin? —David Goldenberg



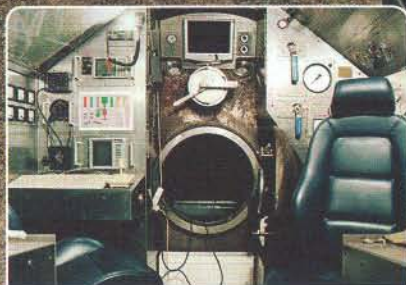


Divers Wanted

To hear **Carsten Standfuss** tell it, a two-day cruise on his boat is like any other weekend excursion. "Three to four people can go, walk around, sleep, eat, drink, and dive for wrecks," he says. Sounds relaxing – until you realize he plans to plunge his guests into the Atlantic Ocean in a 57-ton submarine he built from scratch.

Standfuss, 40, is building *Euronaut*, the world's largest amateur sub, a project he started in 2000 and aims to finish this summer. The 53-foot vessel has a range of 600 miles and can descend more than 1,000 feet. It's propelled by a 190-horsepower diesel engine for surface sailing and an electric motor with 6.5 tons of lead-acid batteries for traveling underwater. Three drop weights under the keel can be released, forcing the sub to surface instantly in case of an emergency (say, a giant squid attack).

When asked how much the *Euronaut* has cost him so far, Standfuss would say only that he's refinanced his house in Berne, Germany, to pay for materials. Of course, the guy knows his way around a submarine: He built the world's smallest personal sub at age 22, a 9.8-footer that set a Guinness world record in 1989 (it has since been broken). Standfuss subsequently became a serious wreck diver, but the North Sea is often too difficult to navigate with a surface ship. "The weather is bad, the currents are fast, and there's a lot of traffic." The *Euronaut* features a pressurized chamber for divers entering and exiting the vessel, and for eating and sleeping while they decompress. It makes riding around in an oversize tin can seem almost ... safe. — **Bob Parks**



The bridge of Standfuss' home-built sub.

The Best: 10 Harrison Ford Lines



"Hokey religions and ancient weapons are no match for a good blaster at your side, kid."
— Han Solo, *Star Wars*

"You want to talk to God? Let's go see him together."
— Indiana Jones, *Raiders of the Lost Ark*

"The report would be 'Routine retirement of a replicant,' which didn't make me feel any better about shooting a woman in the back."
— Rick Deckard, *Blade Runner*

"Laugh it up, fuzzball."
— Han Solo, *The Empire Strikes Back*



"It's not the years, honey; it's the mileage."
— Indiana Jones, *Raiders of the Lost Ark*

"The earth moved. The angels wept. The Polaroids are ... uh ... are in my other coat."
— Jack Trainer, *Working Girl*



"When you find the colonel, infiltrate his team by whatever means available and terminate the colonel's command."
— Col. Lucas, *Apocalypse Now*

"Hey, you're supposed to be the fastest thing in the valley, man. But that can't be your car. It must be your mama's car! I'm sort of embarrassed to be this close to you!"
— Bob Falfa, *American Graffiti*

"She may not look like much, but she's got it where it counts, kid."
— Han Solo, *Star Wars*



"Strictly speaking, there's no such thing as invention, you know. It's only magnifying what already exists."
— Allie Fox, *The Mosquito Coast*

Compiled by Warren Graff



DIAL-A-FACT

Get the 411 on Anything

You can call on Infone for movie times, Google Mobile for stock info, and Dodgeball to locate drinking buddies. But what if you want to know about cold fusion? The new cell phone service Ask Me Now answers any query in minutes with a text message. Easy questions are free; hard ones cost 49 cents. How smart is it? We gave the service a pop quiz to find out. — James Lee

WIRED: Who had the best-selling album of 1988?
ASK ME NOW: "Bestselling Album of 1988 is the album *Kylie* of artist Kylie Minogue."
Grade: D- Only in the UK and Australia. Here in the US, George Michael's *Faith* topped the charts.

Is cold fusion possible?
"There are a number of suggested processes by which cold fusion may occur, although currently none of these has been shown to release more energy than is required to sustain the reaction: a requirement for the process to be useful for producing power ..."
Grade: A++. Jumpin' gigawatts! Great answer.

How many licks does it take to get to the center of a Tootsie Pop?
"A group of engineering students from Purdue University recorded that their licking machine, modeled after a human tongue, took an average of 364 licks to get to the center of a Tootsie Pop.

They tried the same licking test on 20 volunteers and found that the average licks to the center were 252."
Grade: A. Next question: How much wood would a woodchuck chuck?

How do you ask "What time is it?" in Klingon?
"What time is it in Klingon is 'arlogh Qoylu'pu'?"
Grade: A+. MajQa'. Uh, we mean "Good work."

Where do babies come from?
"To make a baby you need a sperm cell and an egg cell. The sperm cell comes from the daddy and the sperm cell comes from the mommy. When the sperm and egg meet, they make a tiny baby that is smaller than a grain of salt. The baby grows in the mommy's tummy for nine months. Then the baby is ready to come out."
Grade: C- Uh, that's too many sperm cells. Stick with the birds and the bees.

Overall grade: B



YOU'RE SO BUSTED

Building a Better Speed Trap

Warning: The next time you're watching the road, it might be watching you. The FBI, Department of Homeland Security, and Alabama Department of Transportation have tested a speed trap device that hides inside reflective lane markers. Made by UK-based Astucia Traffic Management Systems, the detection stud throws an infrared beam across the pavement and, when a car passes, gauges its speed by measuring how long the beam is interrupted. Meanwhile, a digicam records the license plate. The data is sent to a computer over a GPRS cell network, allowing for remote ticketing. — Erin Biba

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Corporate Branding Strikes Out

Where fans aren't buying into stadium sponsorships

What's in a name? In some cities, sports stadium monikers convey civic pride and team spirit. That's great for the faithful who pack Fenway Park, Wrigley Field, and Yankee Stadium. But most fans are now filing into places with names like US Cellular Field, HP Pavilion, and Minute Maid Park. North American companies have shelled out \$1.9 billion to rebrand these and 35 other pro sports venues. With mergers and acquisitions, some arenas have been renamed three times. Where's the loyalty? Not here. Tired of the runaround, some fans aren't playing along. — Erik Malinowski

AT&T Park Pac Bell Park

HOME OF: San Francisco Giants
SPONSORSHIP: \$53 million, until 2019
FORMER NAMES: Pacific Bell Park, SBC Park
HISTORY: The gem of San Francisco Bay, Pacific Bell Park quickly won over baseball fans when it opened in 2000. And though its original corporate namesake was dissolved by parent SBC — which then bought AT&T and will soon transition to that brand — locals are loyal to the Pac Bell name.

Qualcomm Stadium The Q

HOME OF: San Diego Chargers
SPONSORSHIP: \$18 million, until 2017
FORMER NAMES: San Diego Stadium, Jack Murphy Stadium
HISTORY: The pro football stadium was once renamed for beloved local sportswriter Jack Murphy. In 1997, local tech firm Qualcomm offered to help fund needed renovations in exchange for naming rights.

Chase Field The Bob

HOME OF: Arizona Diamondbacks
SPONSORSHIP: \$66 million, until 2028
FORMER NAME: Bank One Ballpark
HISTORY: In 1998, the Arizona Diamondbacks brought professional baseball to the Southwest and a stadium to downtown Phoenix. Bank One initially held the naming rights, but a merger with Chase spelled the end of the Bob. The Jacuzzi behind the right-field fence? Not going anywhere.

Monster Park The Stick

HOME OF: San Francisco 49ers
SPONSORSHIP: \$6 million, until 2007
FORMER NAMES: Candlestick Park, 3Com Park
HISTORY: One of football's greatest dynasties — the Joe Montana-led 49ers of the '80s — made Candlestick Park home to some famous plays. 3Com stuck it to fans in 1996 with a naming rights deal, but when that expired, the Stick returned — only to have Monster Cable strike a new contract with the city in 2004.

Qwest Field Seahawks Stadium

HOME OF: Seattle Seahawks
SPONSORSHIP: \$75 million, until 2019
FORMER NAME: Seahawks Stadium
HISTORY: The effort to build what's considered pro football's best stadium was spearheaded by Microsoft cofounder and team owner Paul Allen. The venue kept the Seahawks name for only two seasons before telecom giant Qwest came calling in 2004.

Official Name

What Fans Call It

US Cellular Field The Cell

HOME OF: Chicago White Sox
SPONSORSHIP: \$68 million, until 2026

FORMER NAME: Comiskey Park
HISTORY: In 1991, the new Comiskey Park replaced its predecessor, which became a parking lot. The legendary name was kept until the naming rights were sold in 2003. But with the team's first World Series championship in 88 years, Chicago fans don't complain much any more.

Wachovia Center The Wack

HOME OF: Philadelphia 76ers, Philadelphia Flyers

SPONSORSHIP: \$40 million, until 2025
FORMER NAMES: CoreStates Center, First Union Center

HISTORY: Built to replace the Spectrum (made famous in *Rocky*), the Wack has been a forerunner of name changes run amok since it opened in 1996. It also paved the way for financial sponsors to overrun the City of Brotherly Love like no other sporting town.

TD Banknorth Garden The Garden

HOME OF: Boston Celtics, Boston Bruins

SPONSORSHIP: \$120 million, until 2025

FORMER NAME: FleetCenter

HISTORY: Rats and all, the beloved Boston Garden intimidated opponents for 67 years before being replaced by the FleetCenter a decade ago. When the naming rights were dumped following Fleet's acquisition, TD Banknorth stepped in to give Bostonians a taste of the old days – at least in name.

Mellon Arena The Igloo

HOME OF: Pittsburgh Penguins
SPONSORSHIP: \$18 million, until 2009

FORMER NAME: Civic Center

HISTORY: Hockey fans filed into the Igloo for 32 years before Pittsburgh-based Mellon Bank slapped on a corporate logo. The move proved prescient when, less than two years later, the Steel City christened football and baseball stadiums named by local companies.

Minute Maid Park The Juice Box

HOME OF: Houston Astros
SPONSORSHIP: \$100 million (estimate), until 2030

FORMER NAMES: Enron Field, Astros Field

HISTORY: When Enron collapsed, team officials scrambled to find another sponsor for their homer-friendly park. The juiced-up presence of Minute Maid (a Coca-Cola company) competes with Tampa Bay's Tropicana Field (whose sponsor is owned by PepsiCo).

REBRANDED STADIUMS (AND THEIR FORMER NAMES)

1. KeyArena (Seattle Center Coliseum)
2. Qwest Field (Seahawks Stadium)
3. AT&T Park* (Pacific Bell Park, SBC Park)
4. McAfee Coliseum (Oakland-Alameda County Coliseum, Network Associates Coliseum)
5. Monster Park (Candlestick Park, 3Com Park)
6. HP Pavilion (San Jose Arena, Compaq Center)
7. Arrowhead Pond (Anaheim Arena)
8. Qualcomm Stadium (San Diego Stadium, Jack Murphy Stadium)
9. Chase Field (Bank One Ballpark)
10. US Airways Arena (America West Arena)
11. Pengrowth Saddledome (Olympic Saddledome, Canadian Airlines Saddledome)
12. Rexall Place (Northlands Coliseum, Edmonton Coliseum, Skyreach Centre)
13. Edward Jones Dome (Trans World Dome, Dome at America's Center)
14. Savvis Center (Kiel Center)
15. Gaylord Entertainment Center (Nashville Arena)
16. Ameritrust Field (The Ballpark at Arlington)
17. AT&T Center* (SBC Center)
18. Minute Maid Park (Enron Field, Astros Field)
19. US Cellular Field (Comiskey Park)
20. RCA Dome (Hoosier Dome)
21. Quicken Loans Arena (Gund Arena)
22. Mellon Arena (Civic Center)
23. HSBC Arena (Marine Midland Arena)
24. Rogers Centre (SkyDome)
25. Corel Centre (The Palladium)
26. Bell Centre (Molson Centre)
27. TD Banknorth Garden (FleetCenter)
28. Continental Airlines Arena (Brendan Byrne Arena)
29. Wachovia Center (CoreStates Center, First Union Center)
30. M&T Bank Stadium (Ravens Stadium, PSINet Stadium)
31. FedEx Field (Jack Kent Cooke Stadium)
32. RBC Center (Raleigh Entertainment and Sports Arena)
33. Bank of America Stadium (Carolinas Stadium, Ericsson Stadium)
34. Alltel Stadium (Jacksonville Municipal Stadium)
35. TD Waterhouse Centre (Orlando Arena)
36. Tropicana Field (Florida Suncoast Dome, Thunderdome)
37. St. Pete Times Forum (Ice Palace)
38. BankAtlantic Center (Broward County Civic Arena, National Car Rental Center, Office Depot Center)

* projected renaming

jargon watch

Promatorium

n. A crematorium in which the body is frozen in liquid nitrogen then shattered with ultrasonic vibration. The process, called promession, was developed by a Swedish company as an ecological alternative to traditional funerary practices.

Pathosphere

n. The pool of genetic material freely traded among pathogens, making the exchange of antibiotic-resistant genes as easy as file-sharing.

Cleanskins

n. pl. Law-enforcement slang for neophyte terrorists who, for want of criminal records, cannot be identified prior to an attack. The term was first used by ranchers referring to unbranded cattle.

Brickware

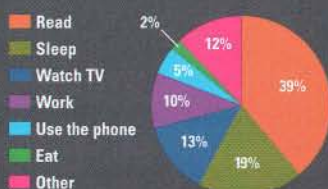
n. Malignant software designed to "brick" – or disable – a game console. Victims are lured by promises of added (and illegal) functionality, so some suspect that brickware is backed by corporate interests.

— Jonathon Keats
(jargon@wiredmag.com)

pulse

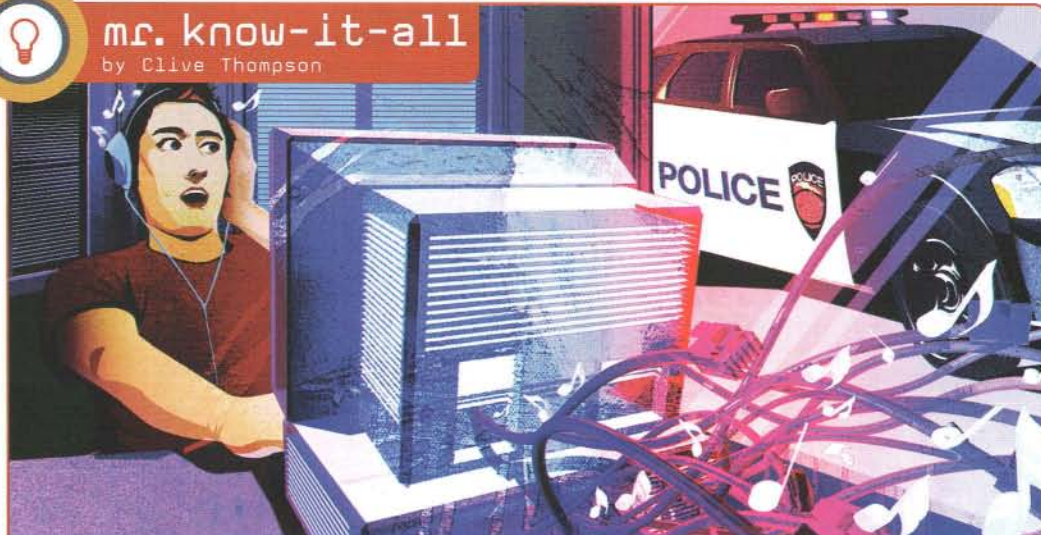
The age of automobile autopilots is near (see "Say Hello to Stanley," page 130). Almost 60 percent of 778 *Wired* readers surveyed said that if they weren't driving, they'd spend their commute reading or sleeping.

If your car could drive itself, what would you most likely do during your travel time?



mr. know-it-all

by Clive Thompson



How Can I Swap Safely?

I admit it: I'm a pirate. I download MP3s of copyrighted songs I don't own, and I've got about 500 so far. I'm also experimenting with BitTorrent (loved King Kong!). What are my chances of getting sued by the RIAA or the MPAA? At what point will they come and break down my door?

The short answer? There's no such thing as breaking the law *just a little*. One illegally downloaded song is enough to land you in court, matey.

The long answer? About 9 million Americans trade files on peer-to-peer networks, and only about 16,000 people have been sued. That means you have a 1-in-560 chance of being nabbed. But, as with sexually transmitted diseases, there are risky behaviors you should avoid. The Recording Industry Association of America appears to be targeting college students using campus networks and people who traffic in Top 40 gold from the major labels. So, all you Princeton brats using the fat university pipe to Hoover up 50 Cent's latest joint – watch your backs. But if you're a dropout copying whiny, unsigned local alt-rock, knock yourself out.

There are also several tech tricks to minimize your risk. Disable Remote Browse on your filesharing software and – presto! – the RIAA can't scan your computer to see what tunes you're hoarding. It can tell you're uploading and downloading but has no idea what's in your collection. The latest versions of most filesharing applications are set up to disallow browsing automatically, so you have no excuse for making this error. Indeed, the only people stupid enough to let the RIAA into their hard drives tend to be newbies with 4-year-old versions of Kazaa. Which explains why the recording industry has wound up suing so many doddering pensioners and 13-year-olds who download "Happy Birthday."

To fly even further under the radar, avoid the most popular downloading apps like Morpheus and

eDonkey and stick to lesser-known ones like Soulseek. And to go completely dark, use instant messaging to trade songs one by one, or try the sneakernet approach: Load songs onto a keychain drive and walk 'em over to your friends' laptops.

Frankly, given how easy it is to avoid detection, it's kind of amazing anyone still gets caught. "At this point, it really seems to be gross negligence on the part of the filesharer," says Eric Garland, CEO of market research firm BigChampagne.

With BitTorrent, the threat to your safety is increasing by the minute. For a while, it looked as though the Motion Picture Association of America was targeting only BitTorrent "trackers" – sites that index Torrent files. But this fall, the organization sued 286 individual downloaders whose names had been disclosed by trackers. When asked if individuals were at risk of legal action, MPAA representatives said "absolutely." As with music, though, the odds of getting sued are still pretty long.

That said, here's a disclaimer: Nothing in this column should be construed as advice to break the law. If you can't do the time, don't do the crime.

A friend of mine is on my blog roll, but his blog has become really lame. How do I drop him from my list without pissing him off?

Very, very carefully. A blog roll is a public declaration of affinity; to axe someone is the ultimate digital diss. So the trick, says Jason DeFillippo, founder of BlogRolling.com, is to take down your entire blog roll. Then, slowly repopulate it over the next few days, making it look like you're starting from scratch and rethinking the whole thing. Put in a bunch of new sites to help preserve this illusion. It'll be less obvious that you've removed only your pal's sucky site.

Need help navigating life in the 21st century? Email mrknowitall@wiredmag.com.

Reel adventure

Marcus trades in the island of Manhattan for New Zealand's South Island mecca of anything and everything outdoors: Queenstown.

100% PURE NEW ZEALAND

with Marcus Samuelsson

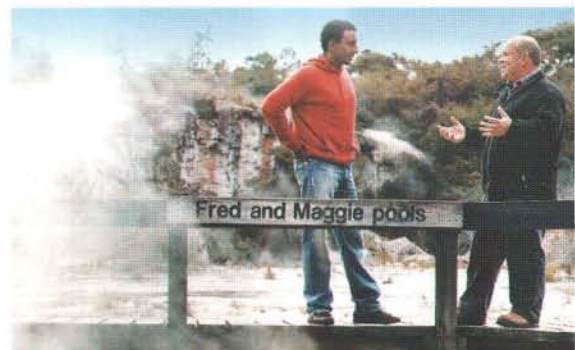
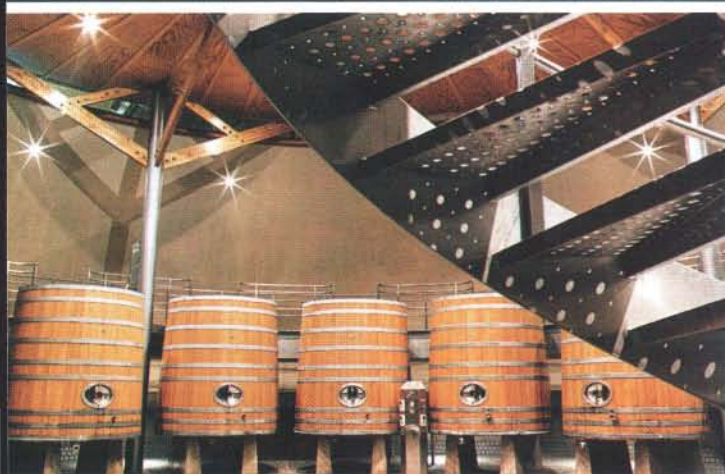
A good chef takes basic ingredients and creates a meal. A great chef uncovers subtleties and creates an unforgettable experience. Tastes. Smells. Sights. Sounds. For an uncompromising 100% pure experience, chef Marcus Samuelsson of New York's renowned Aquavit Restaurant traveled to the source: New Zealand, the unforgettable down under.

MARCUS'S 10-DAY NEW ZEALAND ODYSSEY

Marcus starts in the North Island city of Auckland. Just a half hour outside the city are parks, beaches, reserves, and hiking trails to explore. Or stay right in the heart of it all and explore downtown's sophisticated cafes and boutiques. "The City of Sails" delivers it all. **Lap of luxury:** The pool at the Auckland Hilton (left) was where Marcus ended his day bathed in the lights of the harbor.



Many people struggle to get back to nature; Kiwis never leave it. Rotorua, Marcus's next stop, not only awakens the senses to the force of nature, it astounds them. Streaks of steam line the skies over volcanic landscapes that hiss with sprouting geysers. Marcus gets close to the action at the Orakei Korako thermal area (right). South of Rotorua is Lake Taupo, where seemingly still waters lie deep. This sapphire blue lake was formed by one of history's largest volcanic eruptions. Today, it's home to unparalleled trout fishing encounters. Something to drink with the catch of the day? Marcus moves on to Hawkes Bay, one of the leading wine producing regions in New Zealand. **Roll out the barrels:** Craggy Range Winery is famous for its Chardonnay (above left). The region's climate is also suited to producing a distinguished selection of reds. **An extraordinary finish:** From reds to greens, Marcus ends his visit to Hawkes Bay at Cape Kidnappers (left), recognized by golf enthusiasts as one of the most spectacular courses in the world.

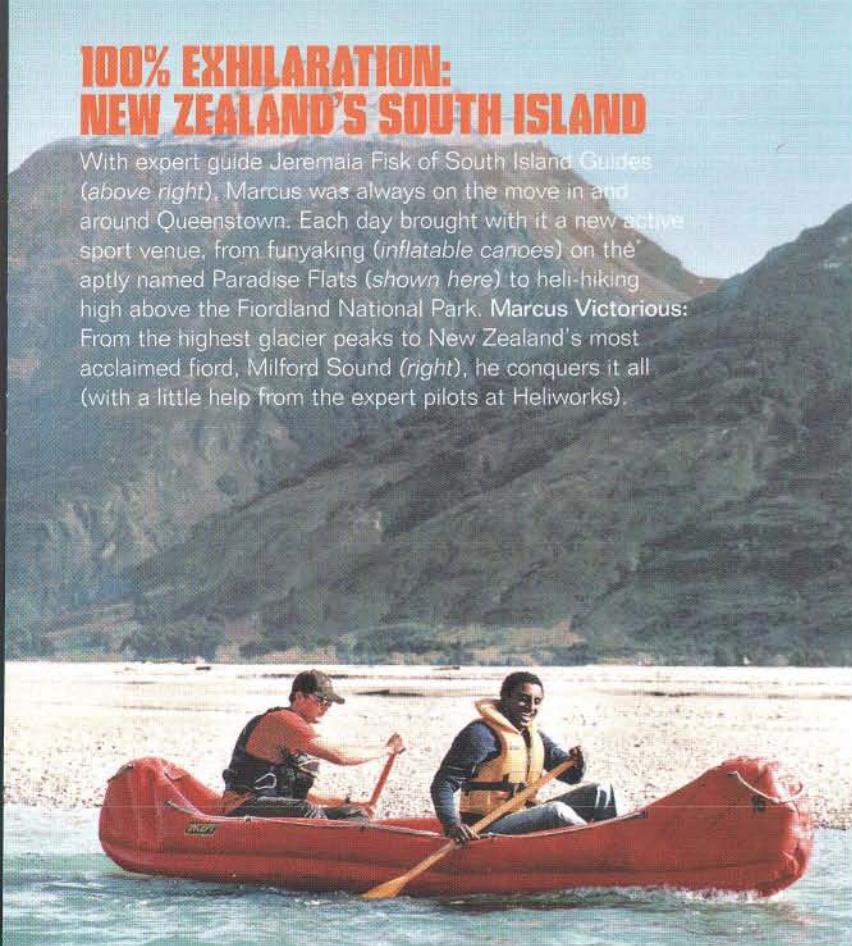


The influence of the indigenous Maori people is felt in the names of places throughout New Zealand, which is known in Maori as Aotearoa—Land of the Long White Cloud. On a day trip to Mokoia Island (in Lake Rotorua), Marcus views edible plant life with chef Charles Royale, whose innovative recipes feature traditional Maori wild herbs (below left). **Tongue-tied:** Marcus gets a "haere mai" [welcome] from local Maori boys (below center). **By a nose:** Marcus engages in a traditional Maori greeting, the hongi.



100% EXHILARATION: NEW ZEALAND'S SOUTH ISLAND

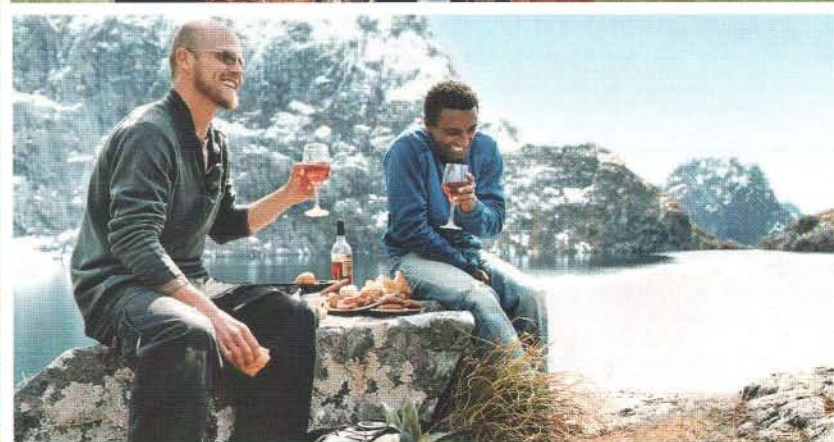
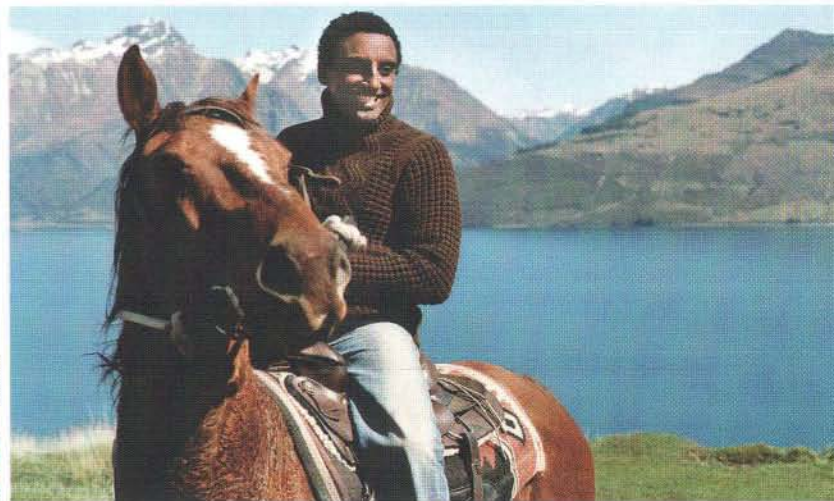
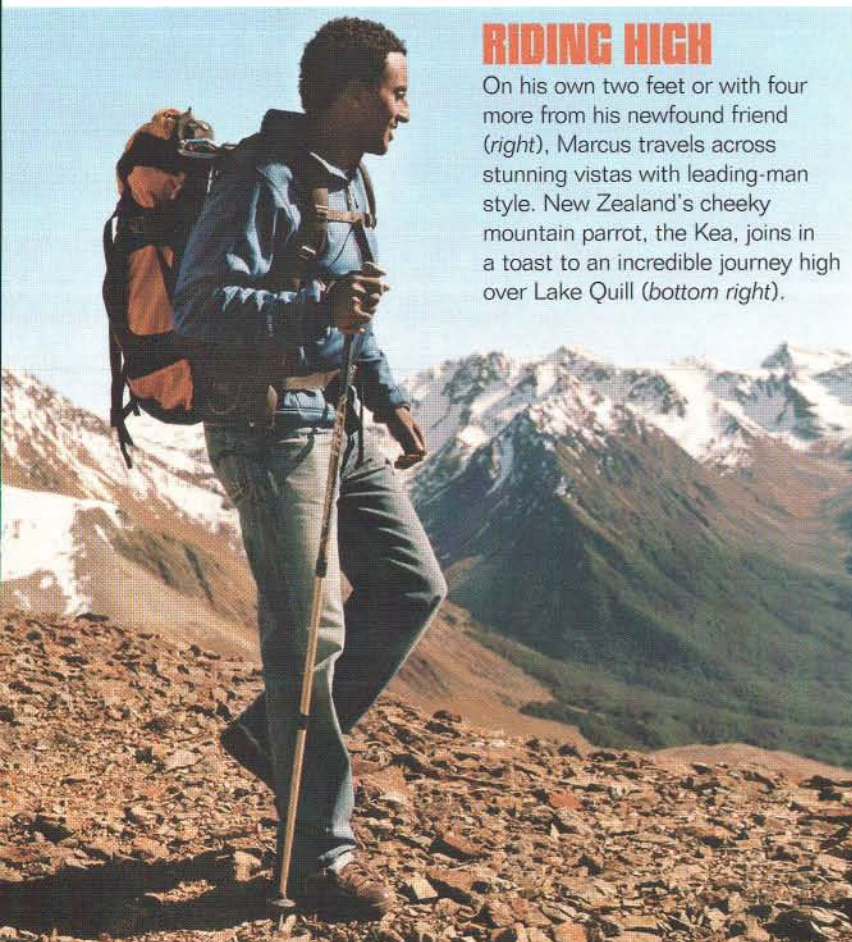
With expert guide Jeremia Fisk of South Island Guides (above right), Marcus was always on the move in and around Queenstown. Each day brought with it a new active sport venue, from funyaking (inflatable canoes) on the aptly named Paradise Flats (shown here) to heli-hiking high above the Fiordland National Park. **Marcus Victorious:** From the highest glacier peaks to New Zealand's most acclaimed fiord, Milford Sound (right), he conquers it all (with a little help from the expert pilots at Heliworks).



The heart of New Zealand is its people. They're a different breed altogether. The beauty of New Zealand defies words. But somehow the lakes are bluer, the mountainsides greener, and the sky more majestic than anywhere else in the world—simply because a Kiwi's smile wills it to be so.

RIDING HIGH

On his own two feet or with four more from his newfound friend (right), Marcus travels across stunning vistas with leading-man style. New Zealand's cheeky mountain parrot, the Kea, joins in a toast to an incredible journey high over Lake Quill (bottom right).



FOR AN IN-DEPTH LOOK AT MARCUS'S EXCLUSIVE VACATION ITINERARY VISIT WWW.NEWZEALAND.COM



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The exhibition is made possible by Intel Corporation and Porsche AG. Additional support is provided by the Alfred P. Sloan Foundation. Media sponsorship is provided by **Wired** Magazine.

Teddy Newton. *The Jumper* collage from *The Incredibles*. © Disney • Pixar



Blue chip: Colts QB Peyton Manning

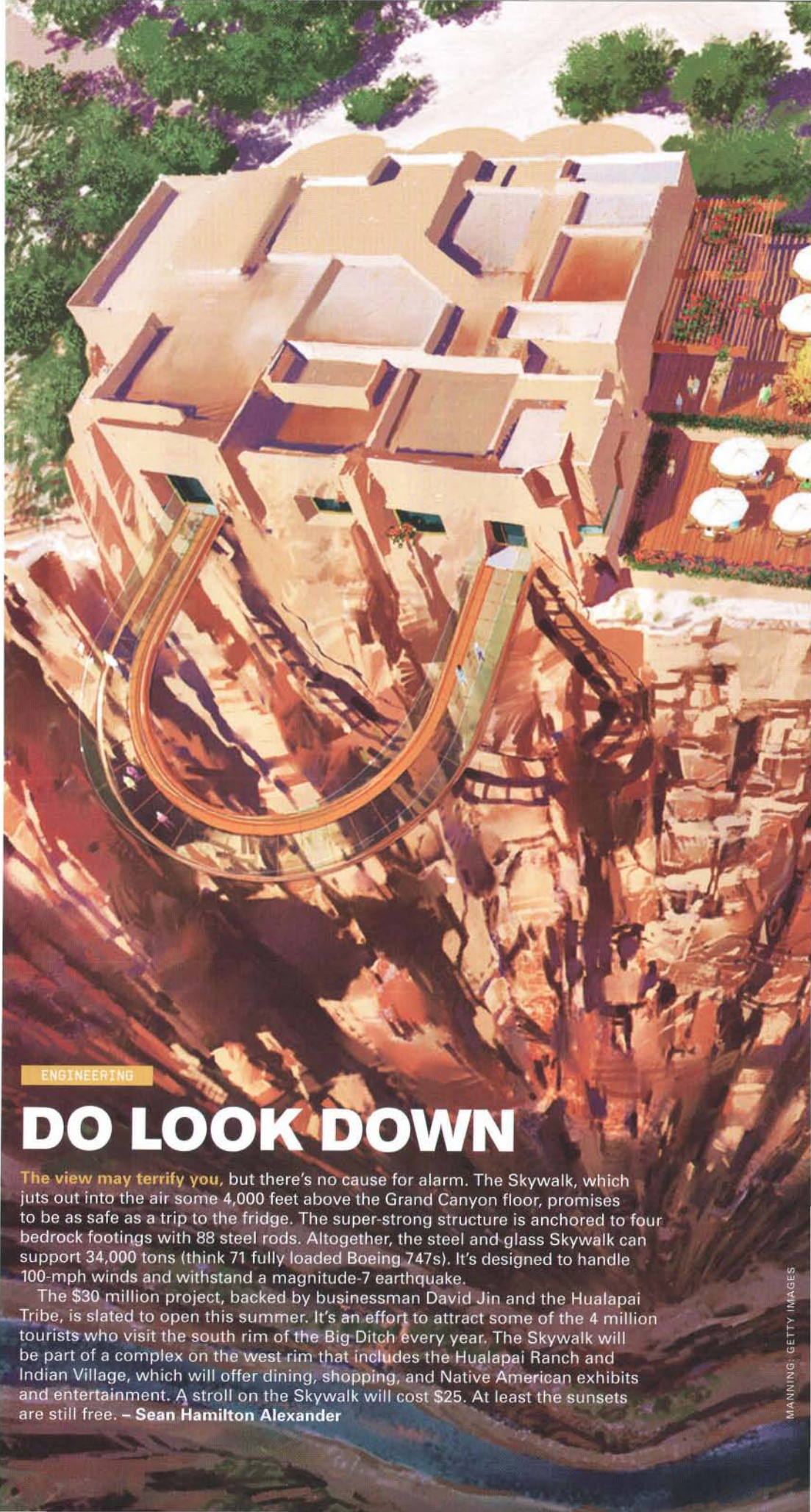
UPDATE

ANOTHER KIND OF NFL TRADE

Jeff Ma is running the numbers again. For much of the '90s, he led a team of fellow MIT outlaws in a card-counting scheme that took casino blackjack tables for millions. Writer Ben Mezrich tabulated his adventures in *Wired* issue 10.09.

Now Ma is doing the math on professional athletics. He and Mike Kearns, a former sports agent, have founded ProTrade, a Web site based on Ma's algorithms that works like a stock market for pro football players (and soon, basketball players). Shares in such perennial all-stars as Peyton Manning and Tom Brady are comparable to blue-chip stocks, while a piece of rookie Cowboys running back Marion Barber represents a far greater risk. No money changes hands — yet — although ProTrade will award prizes at the end of the season to investors with the top-performing portfolios. More than 150,000 visitors checked out the site in October, its first month.

Ma's system has impressed some sports organizations so much that they've hired him to consult on game plans. The NBA's Portland Trailblazers used Ma's analysis to help with its 2005 draft, and Ma has had an ongoing relationship with an NFL team that asked not to be named. "They showed us that while player X might lead the league in yards per carry, he stinks on third-and-short situations," says a front-office executive with the team. "No one else is teasing out the data like that." — Jeff Howe



ENGINEERING

DO LOOK DOWN

The view may terrify you, but there's no cause for alarm. The Skywalk, which juts out into the air some 4,000 feet above the Grand Canyon floor, promises to be as safe as a trip to the fridge. The super-strong structure is anchored to four bedrock footings with 88 steel rods. Altogether, the steel and glass Skywalk can support 34,000 tons (think 71 fully loaded Boeing 747s). It's designed to handle 100-mph winds and withstand a magnitude-7 earthquake.

The \$30 million project, backed by businessman David Jin and the Hualapai Tribe, is slated to open this summer. It's an effort to attract some of the 4 million tourists who visit the south rim of the Big Ditch every year. The Skywalk will be part of a complex on the west rim that includes the Hualapai Ranch and Indian Village, which will offer dining, shopping, and Native American exhibits and entertainment. A stroll on the Skywalk will cost \$25. At least the sunsets are still free. — Sean Hamilton Alexander

a very fine year

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START



GREENHOUSE GASES

Polluting the Biosphere

Our future lies inside these greenhouses. Ecologists at England's Lancaster University established one of the world's biggest solar dome complexes – 20 enclosures in all – to study the long-term effects of pollution. The scientists spread 8.5 tons of high-grade Kansas prairie soil inside a dozen of the energy-efficient glass structures and planted each with 44 trees. Then they pumped varying levels of carbon dioxide into the domes, simulating the projected atmospheric concentrations on Earth in 25, 50, and 95 years. For nearly two decades, researchers have theorized that forests could soak up CO₂ from the air and store it harmlessly. Officials in Australia, Canada, Japan, and the US hoped this would allow their countries to meet Kyoto Protocol emissions targets without cutting consumption of fossil fuels. No such luck. The Lancaster team found that as greenhouse gas levels rise, plants and soil lose their ability to absorb and hold CO₂. The scientists estimate that Earth's forests could be saturated by 2025. Well, at least there's plan B: Pump all that excess CO₂ into the oceans. – **Greta Lorge**

wired	\$100 laptop	American Inventor	loathing Sony for XCP rootkit	soap strips
tired	\$2 wine	America's Next Top Model	loathing Sony for Atrac3 audio files	aspirin strips
expired	99-cent menu	American Idol	loathing Sony for Memory Sticks	breath strips

hotseat

XM Satellite
Radio CEO
Hugh Panero



THE HOWARD STERN FACTOR

XM rules satellite radio: It has 5 million subscribers, double that of rival Sirius. But it doesn't have Howard Stern. The self-styled king of all media can attract as many as 6 million listeners a week, and Sirius has committed more than \$620 million to bringing him and other marquee talent aboard to build its audience. This month, Stern takes his foul mouth to Sirius. We asked XM boss Hugh Panero whether he's worried. – **Lucas Graves**

WIRED: Howard goes live January 9. Will that date live in infamy at XM?

PANERO: It's going to bring a lot of publicity to satellite radio, and the cost associated with that will be passed on to my competitor, who's paying half a billion dollars for a risky fixed-content deal.

Still, Howard Stern, Martha Stewart, a channel produced by Eminem – has Sirius cornered the market on big-name talent?

We've got Ellen Degeneres, Snoop Dogg, Tyra Banks, Al Franken, and Bob Edwards, along with Major League Baseball and the NHL. But you have to balance programming, technology, and distribution. You need radios that are attractive and affordable; we've won awards for ours. And we have deals to factory-install them with GM, Honda, Toyota, Hyundai, and Nissan.

Competition with Sirius jacks up the cost of every deal either of you make. Could that strangle this industry while it's still in the cradle?

Competition is good: Sirius has made us better, and we've made them better.

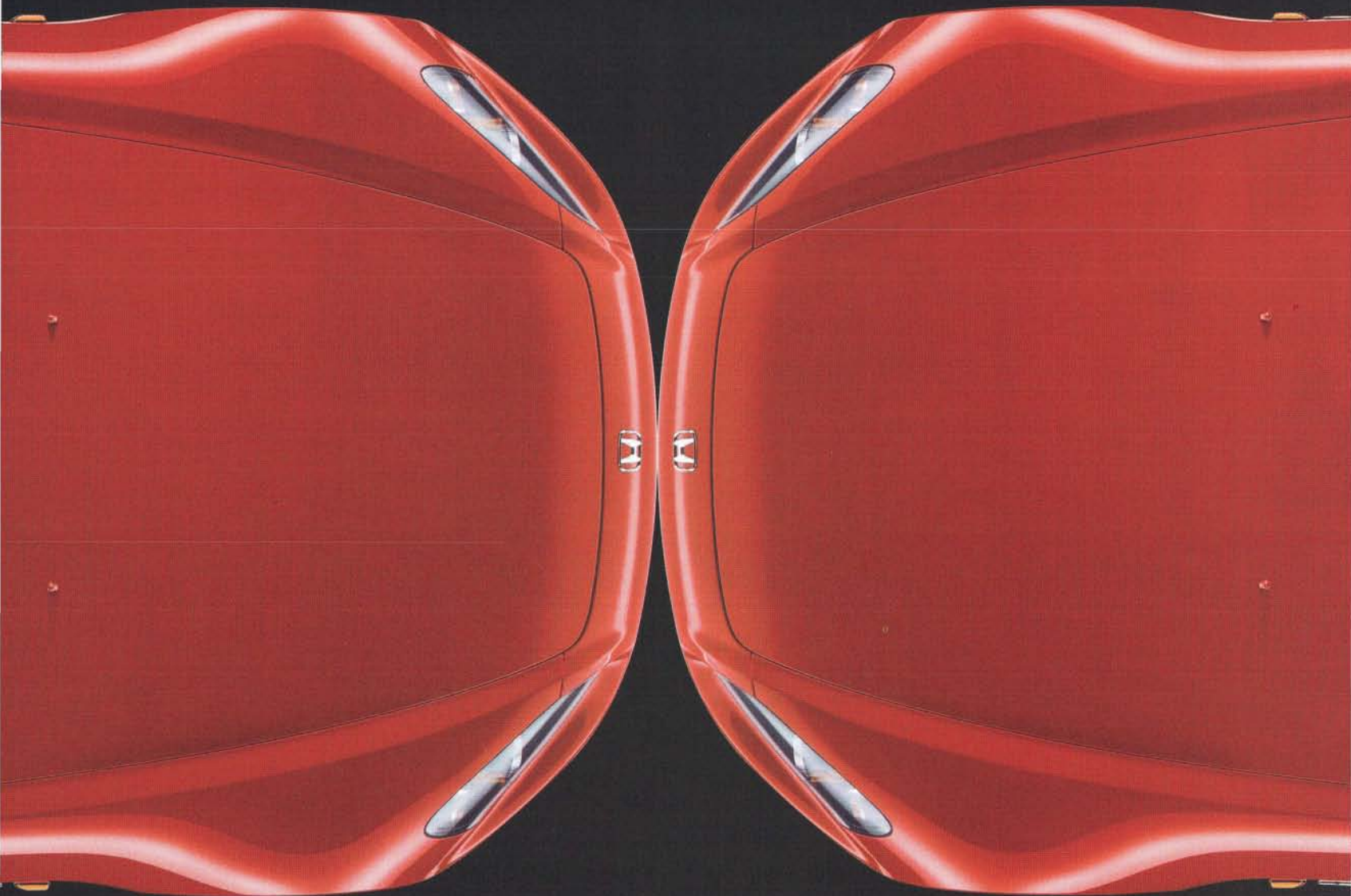
People would go nuts if Jon Stewart were only on Comcast or if you had to pick Cablevision to get HBO. Why should we have to choose?

People aren't going crazy about that – it happens every day. You have to make a choice between getting EchoStar or DirecTV, and they offer different content.

Cable started out commercial free. Once satellite radio is established, are you going to sell us out to Madison Avenue?

We have always sold advertising on our talk channels, but our music channels will remain commercial free. People subscribe to us because they're tired of getting 18 minutes an hour of advertising on traditional radio.

★ It's got punch. ★



When it's time to go toe-to-toe, the S2000's 237-hp engine and 8000-rpm redline will definitely give you the upper hand.

Everybody Wants a Piece of You

One-fifth of your DNA is now owned (as in patented) by someone else.

You've heard of patenting PC parts, but human parts? Organizations are now patenting sequences of nucleotides so they can license the rights to other companies that use the sequences to develop drugs or diagnostic tests. In a sense, the institutions that hold these patents own the intellectual property rights to you – nearly a fifth of you, in fact. A new study from researchers at MIT shows that 4,270 US patents have been issued for 4,382 individual human genes – almost 20 percent of the entire genome. "Patents appear to be concentrated in areas relevant to human disease and biological pathways," says Fiona Murray, a professor

A LOOK AT CHROMOSOME 12

374 total patents (sections highlighted in black)

Gene: A2M

Significance: Linked to Alzheimer's disease and emphysema

Patent holders: General Hospital Corporation, Incyte

Gene: ADCY6

Significance: Associated with an enzyme found in thyroid and brain tissues

Patent holder: Millennium Pharmaceuticals

Gene: CACNB3

Significance: Involved in the release of neurotransmitters and hormones

Patent holders: American Home Products*, Bayer, Merck, SIBIA Neurosciences*

Gene: RDH5

Significance: Related to night blindness

Patent holders: Ludwig Institute for Cancer Research, PE Corporation*

Gene: CD4

Significance: Linked to Lupus and a form of white blood cell deficiency

Patent holders: Columbia University, General Hospital Corporation, Incyte, United States of America, University of Pennsylvania, Wistar Institute

Gene: DHH

Significance: Plays a role in regulating development of reproductive organs and the nervous system

Patent holders: Biogen*, Curis

Gene: IL22

Significance: Involved in inflammatory bowel disease and Crohn's disease

Patent holders: Genentech, Ludwig Institute for Cancer Research

Gene: P2RX7

Significance: Linked to chronic lymphatic leukemia

Patent holders: Glaxo*, Incyte

Top 10 Holders of Gene Patents

PATENT HOLDER NO. OF GENES PATENTED

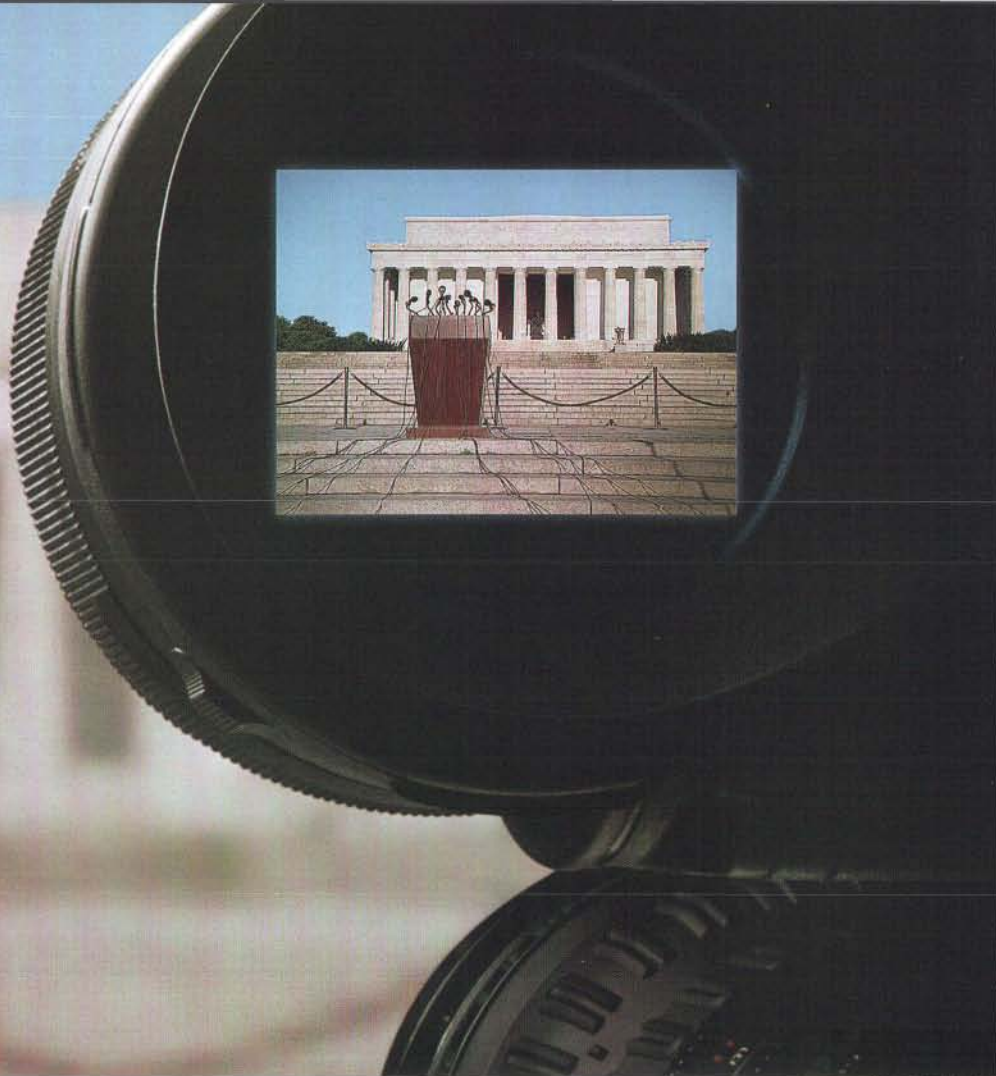
1 Incyte	about 2,000
2 Millennium Pharmaceuticals	142
3 Human Genome Sciences	140
4 Ludwig Institute for Cancer Research	90
5 The Regents of the University of California	89
6 SmithKline Beecham*	79
7 Applera	59
8 Isis Pharmaceuticals	58
9 Genetics Institute*	53
10 Lexicon Genetics	48

* Company has since merged, been acquired, or changed its name.

Sources: Kyle Jensen and Fiona Murray, MIT; National Center for Biotechnology Information

SHARP

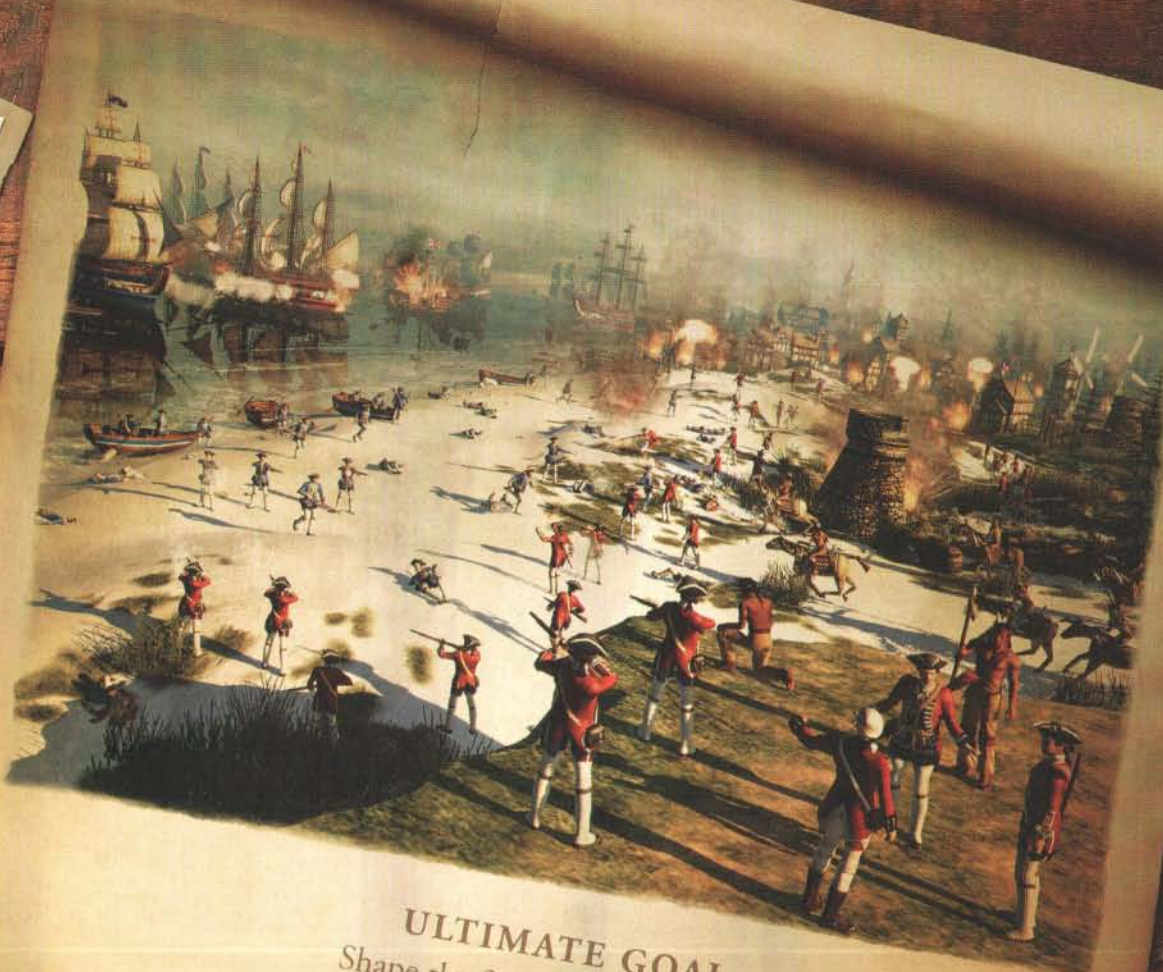
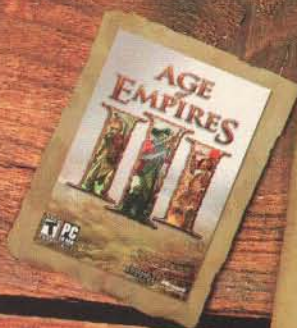
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realtime

January

PLAY

Culture • Gear • Obsessions

SUN MON TUE WED THU FRI SAT

<p>1</p> <p>NEW YEAR'S DAY Wanna see something really scary? (No, not the disciples from last night.) Sober up with 44 episodes of <i>The Twilight Zone</i> on the Sci-Fi Channel. scifi.com</p>	<p>2</p> <p>167 YEARS AGO TODAY Louis Daguerre took the first photo of the moon. There wasn't much detail in the grainy image, but we named a lunar crater for him anyway.</p>	<p>3</p> <p>FIRST IMPRESSIONS OF EARTH The Strokes' new CD, produced by pop-punk hitmaker David Kahne (of Sublime fame), will rock the white belts off hipsters everywhere. thestrokes.com</p>	<p>5</p> <p>INT'L CONSUMER ELECTRONICS SHOW Thirty trade journalists put their geekiness to good use in the Build Your Own PC Race, a charity event at CES in Vegas. charitypcrace.com, cesweb.org</p>
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<p>8</p> <p>BIRTHDAY: DAVID BOWIE Whether he's Ziggy Stardust or the Thin White Duke, Bowie can change his image but he can't ch-ch-change the march of time. He turns 59.</p>	<p>10</p> <p>THE FLASH: THE COMPLETE SERIES Sprint to stores for the DVDs of all 22 installments of the live-action TV series featuring John Wesley Shipp as DC Comics' track-star superhero. warnerbros.com</p>	<p>13</p> <p>NAANOSINGAPORE Catch the last sessions of this four-day con/fab on itty-bitty stuff with numbo-jumbo names. Anyone for bioengineering nanoparticles? ieeeet.org</p>
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<p>15</p> <p>NATIONAL FRESH SQUEEZED JUICE DAY Eat yer vitamins. Or better yet, drink 'em. Wheatgrass lovers say a single ounce of juice has the vitamin and mineral content of 2.5 pounds of veggies.</p>	<p>17</p> <p>WILD ARMS 4 A small-planet boy from the isolated sphere of Ciel finds that there's a whole 'nother world out there. Experience an RPG <i>Titanum Show</i> on PPS today. wildarms4.com</p>	<p>19</p> <p>SUNDANCE FILM FESTIVAL If you flake on Park City this year, don't fret: Event backers have arranged to keep the festivities in Utah till at least 2018. sundance.org</p>
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<p>22</p> <p>MIDEMNET MOBILE Bigwigs from big music—think Sony, MTV, Nokia—compare ring tones and plot the future of mobile tunes at the 40th annual conference in Cannes. midem.com</p>	<p>26</p> <p>CRITICAL SPACE From escape vehicles to breeding units, more than 75 of Andrea Zittel's conceptual, idealistic objects for modern living go on display in NYC. newmuseum.org</p>	<p>27</p> <p>ROVING MARS This Inax documentary from Disney guts you a giant leap closer to the surface of the Red Planet. Let us know if you find any water. disney.com</p>
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<p>29</p> <p>THE FLORIDA EXTRAVAGANZA The colossal fix expo is bigger than ever: 75,000 square feet will fill up with stars from <i>Harry Potter</i>, <i>Lost</i>, and <i>Star Wars</i>. fkshow.com</p>	<p>31</p> <p>ALL-AMERICAN GIRL If you missed Margaret Cho's coming-out party, catch the boundary-busting comedian in reruns. This DVD set has all 19 episodes. shoutfactory.com</p>	<p>28</p> <p>WINTER X GAMES 10 Don your techwear in Aspen/Snowmass to watch 230 athletes compete in moto, skiing, and boarding challenges. Gnarly! espn.com</p>
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Background: Binge on Rod Serling's twisted tales during the *Twilight Zone* marathon January 1.

by Peter Arcuni

THE BEST WORST MOVIE OF THE YEAR

Not even the best marketing team can save a movie from a stupid name. Take New Line's *Snakes on a Plane*. It doesn't come out until August, but it's already a laughingstock. Why the derision? A plot that borders on ridiculous (an assassin releases deadly snakes aboard a flight, terrorizing passengers like Troy, played by Kenan Thompson, left), coupled with an absolutely artless title. The studio tried to change the flick's name to *Pacific Air Flight 121* earlier this year, but star Samuel L. Jackson balked, saying the title was a big reason he signed on. Thing is, the terrible name might end up being the film's saving grace. It caught the attention of meme-happy bloggers who produced songs, apparel, poster art, pages of fan fiction, and even a mock trailer. This attention all but clinches the would-be dud's place in the camp classics hall of fame. — **Eric Steuer**



1



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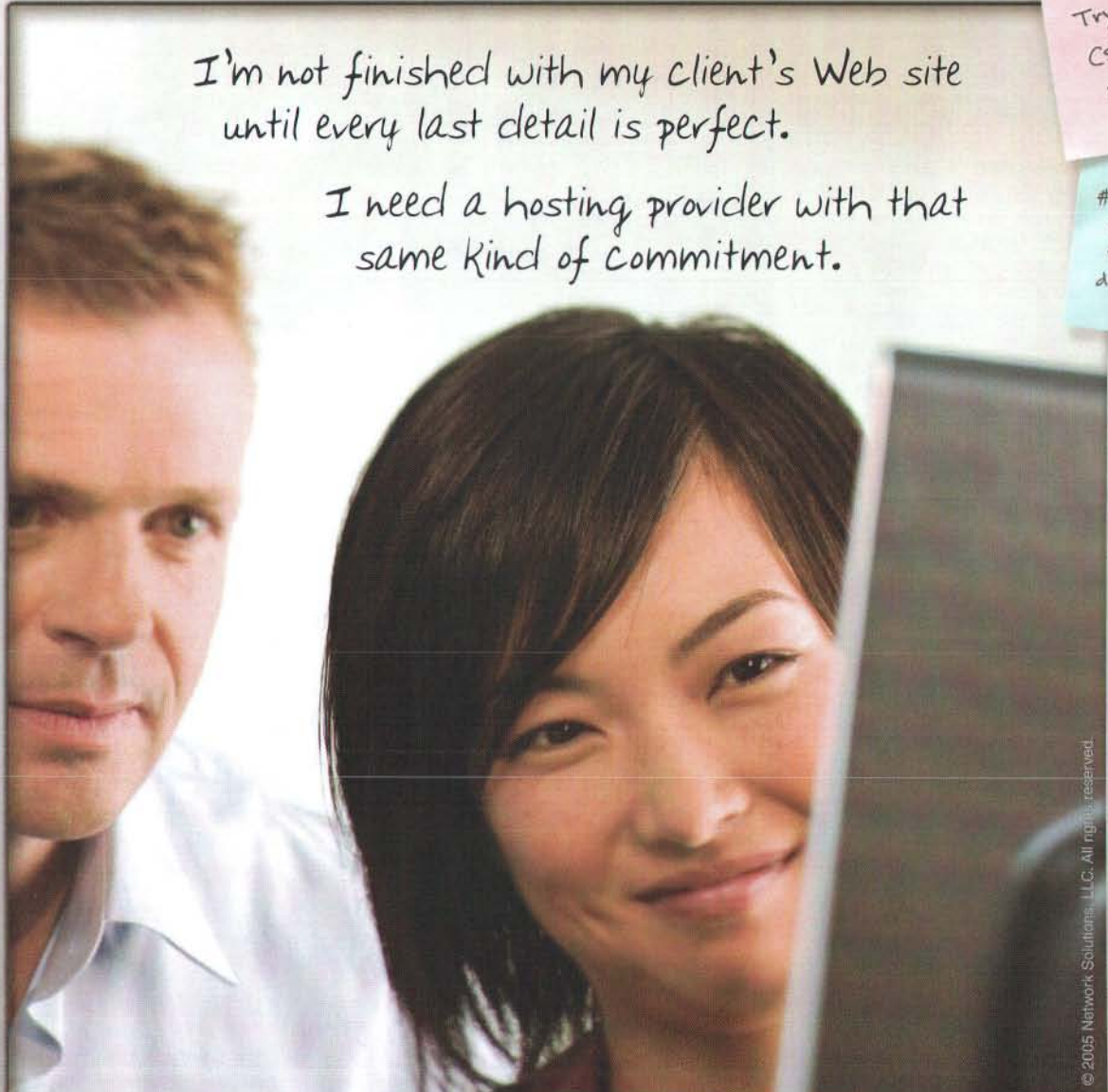
There's no such thing as bad publicity: The unreleased film's awful title inspired bloggers to make a *Snakes on a Plane* poster (1), T-shirt (2), and comic strip (3).



Raw material: One of hundreds of downloadable production shots from Michela Ledwidge's remixable movie.

Hack This Film

Michela Ledwidge wants her film to be more than watchable. She wants it to be remixable. By February, the director plans to post all of the raw material for *Sanctuary*, her 10-minute sci-fi movie about a girl, her computer, and a mysterious murder, on www.modfilms.com. Expect nearly nine hours of production footage, 90 minutes of sound effects and dialog, plus hundreds of storyboards, concept drawings, and still photos. Viewers will be able to manipulate the cinematic elements with downloadable software called Switch. Ledwidge was inspired by game modding: Fans spend untold hours performing retrofits on their favorite titles (famous examples include *Half-Life* and *Quake III*). If her project catches on, *Sanctuary* could turn into the first massively multiplayer online movie. — **Jason Silverman**



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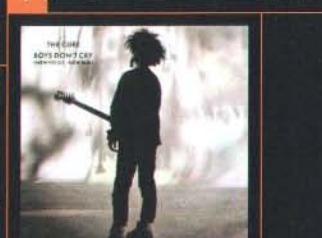
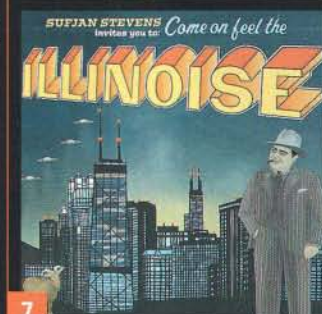
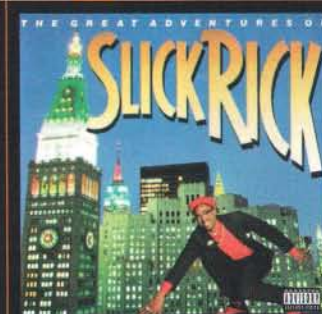
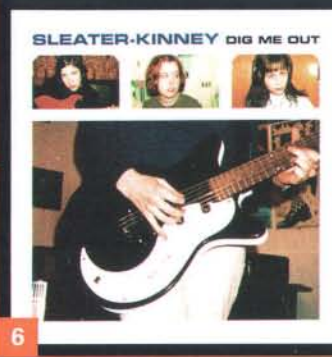
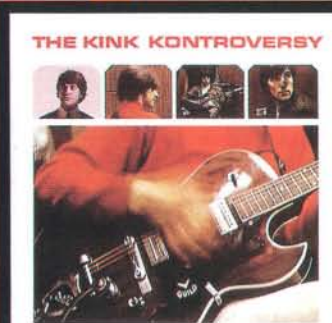
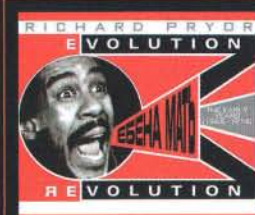
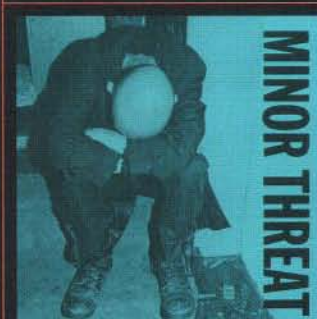
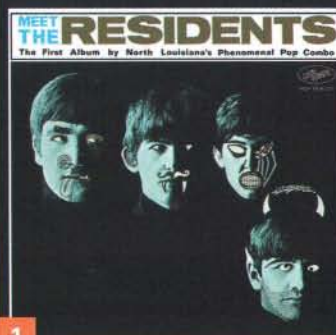
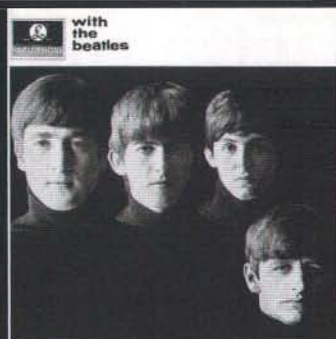
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CALLING OUT THE COPYCATS

If you think you've seen that CD cover before, it's probably because you have. Appropriation of album art is abundant in the pop world: Take Franz Ferdinand's latest disc, which riffs on the same 1924 Soviet poster as a recent Richard Pryor collection. Or the new Sufjan Stevens album, which goofs on a Slick Rick classic. "The designers are twisting the associations we have with pieces of pop culture," says Pete Hilgendorf of the Knockoff Project, a Web site that documents record sleeves and thieves. Artists whose designs are most commonly plundered? The Beatles and Elvis, Hilgendorf says. The biggest repeat offender? Parodist "Weird Al" Yankovic, of course. — Ken Taylor



Rip-off artists: The Residents (1), Rancid (2), Franz Ferdinand (3), Blur (4), Kruder & Dorfmeister (5), Sleater-Kinney (6), Sufjan Stevens (7), Melvins (8), The Mooney Suzuki (9), Depeche Mode (10).



120 not-so-standard features. One all new German engineered Passat. **Drivers wanted.®**

A RACY NEW LITTLE NUMBER

When is a Porsche not a Porsche? When it's a Triposto. Montreal-based mechanics Clyde and Hugh Kwok turned the quintessential sports car – a 1990 Porsche 911 C2 – into a bona fide street racer. They modified its 3.6-liter engine to hit 180 mph (up from 162 mph) and its horsepower to reach 300 (up from 250). Clyde, a retired engineering professor, and his son Hugh, a professional race car driver, also replaced the body with a Kevlar, carbon fiber, and aluminum skin similar to what's on Formula One cars. Though it no longer looks like a Porsche, aficionados won't be fooled: The air-cooled engine still emits the classic growl. And it can be yours for \$250,000, twice the price of the new, fully loaded 2006 Carrera 4S. – **Fred Langan**

BEFORE



AFTER



Bye-bye, backseat: The modded 911 puts the driver in the center with a passenger on either side.



Stop Human Projectiles!

It's not a seat belt, but it's better than nothing: Honda is putting the first airbag on a mainstream motorcycle, its top-end Gold Wing, starting this summer. Safety-conscious riders will pay a yet-to-be-disclosed fee for the option over and above the bike's \$22,800 list. Sensors on the front forks detect an accident and trigger the bag mounted between the handlebars. In a head-on crash, the fabric bubble absorbs some of the rider's forward momentum. He'll still probably wind up on the pavement, but, hey, it beats flying through the air like a human lawn dart. – **Paul A. Eisenstein**

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DRESSING FOR DOOMSDAY

Sixty years after Little Boy and Fat Man obliterated Hiroshima and Nagasaki, the cultural fallout is still fueling Japan's exploding neo-pop art movement. Check out Kenji Yanobe's collection of whimsical doomsday gear like *Yellow Suit*—radiation-safe attire for children and dogs—and *Atom Car*, a postapocalyptic commuter pod. Yanobe's latest creation is *Giant Torayan*, a 25-foot-tall, fire-breathing bot whose voice recognition software responds only to kids. During a recent show at the Toyota Municipal Museum, youngsters reacted with glee when the pyrotechnic bot danced and sang folk songs. Yanobe's next big exhibit takes place in March at the Osaka Contemporary Art Center, also in Japan. — **Todd Jatras**



Postapocalypse now: Above, Kenji Yanobe's *Yellow Suit* for kids and dogs. From left, his *Giant Torayan*, *Mini Atom Suits* (yellow) and *Tanking Machine* (white), and *Rocking Mammoth*.

THE HANDHELD FOR HACKERS

It's clunky. It doesn't have Wi-Fi. It guzzles AA juice. So why is the GP2X gaming-and-media device a must-have among geeks? It's all about the penguin. The \$180 handheld, made by an obscure Korean company called Gamepark Holdings, uses a Linux operating system and ships with a software development kit. The GP2X launched in November without any official titles, but devout users are already writing games and other apps. "You can do anything with this device because it's open source," says Sanghoon Park, a Gamepark department manager. "It's a gift from heaven." Take that, Nintendo and Sony! Here's taste of manna in a plastic case. — James Lee



What the GP2X Can Do



Videos



Images

PLAY MEDIA FILES

This gizmo plays all the ebooks and audio files you can cram onto an SD card (sold separately). It also supports video formats from MPEG-4 to DivX and image formats from BMP to JPEG. Plug the GP2X into a PC via USB to transfer stuff, then connect it to a TV with an S-video cable to screen your latest BitTorrent score.



Retail



Homebrew

RUN NEW GAMES

Gamepark Holdings has deals with developers to release consumer games like *Crazy Kart 2* for the GP2X. The company promises a dozen titles by next summer, including dating sims, adventure games, and arcade actioners. In the meantime, fans are rolling their own, such as puzzlers like *LinesX*.



PC shooters



Super Nintendo titles

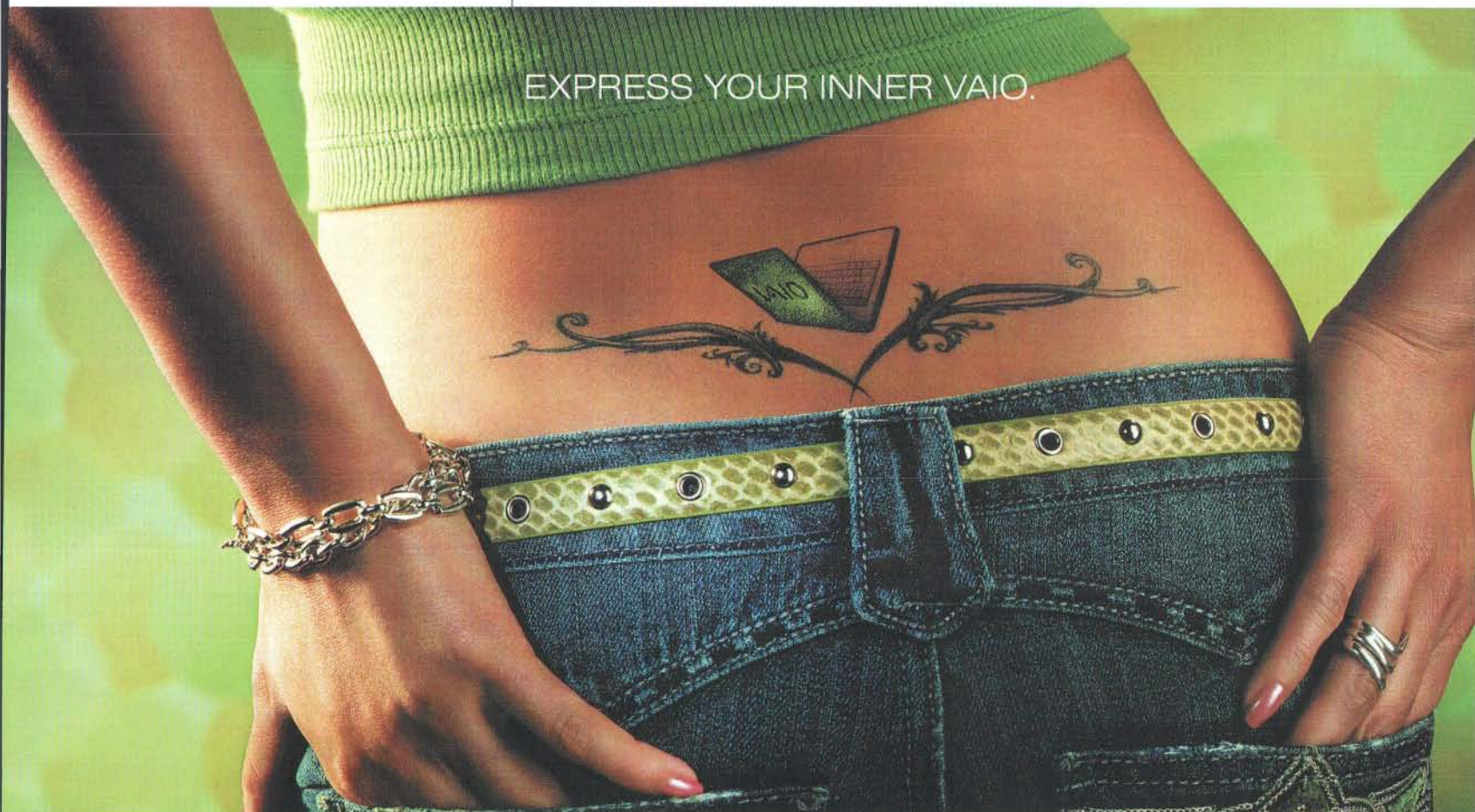
EMULATE CLASSICS

Making software that runs vintage games is a popular hobby among GP2X coders. The PC shooter *Duke Nukem 3D* is playable, and there's an app that handles all of the old Super Nintendo titles like *Super Mario World*. Emulators of coinop classics, Atari 2600, and Commodore 64 are also on the way.

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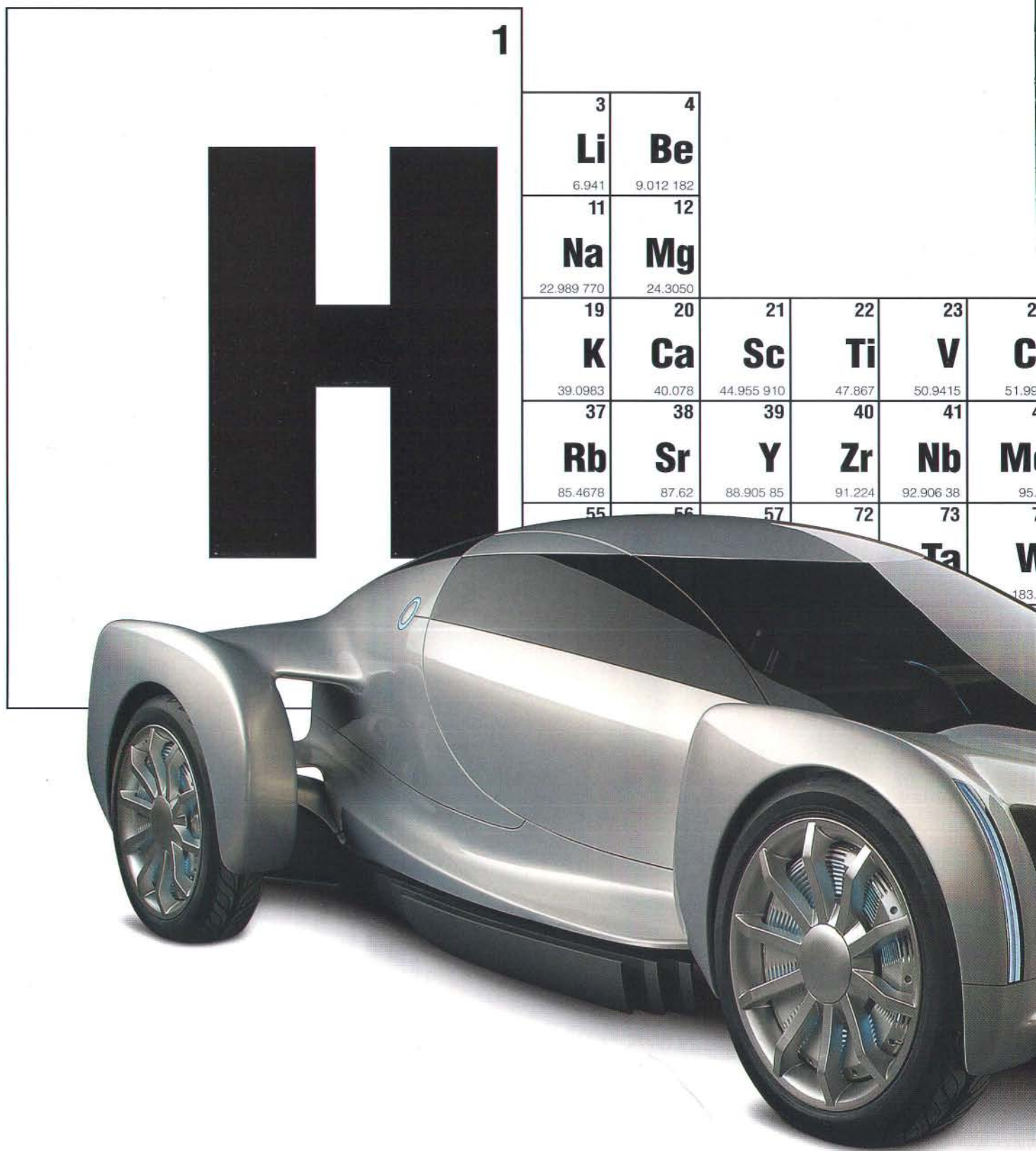
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43 Tc (98)	44 Ru 101.07	45 Rh 102.905 50	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.904 47	54 Xe 131.29
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PLAY

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Wheelin' and dealin': Caravan roams the streets of New York selling clothes and art.

THE MOBILE MALL

Don't even bother with search engines, 411, or the Yellow Pages. The only way to track down Caravan, New York City's hottest new boutique, is by getting real-time GPS coordinates from its Web site. The modded Winnebago regularly cruises from uptown to Brooklyn selling art and clothing. Packed with a GPS transmitter, a plasma screen, and a wireless credit card processing unit (receipts are emailed to customers), the roving 240-square-foot store carries hard-to-find items from trendy labels like Penguin, Modern Amusement, and Catch a Fire. Caravan pulls in \$25,000 to \$30,000 a month even though it accommodates only a dozen shoppers at a time, says cofounder Claudine Gumbel. "We do a lot of appointments for insecure Wall Street guys," Gumbel says, "guys who need a little extra guidance and who like the privacy." The fleet is expanding to Austin, Los Angeles, and Miami, to help a few more rich slobs outrun the fashion police. — **Sonia Zjawinski**



KOREAN
SCHOOLGIRL
WATCH

Saving Face Cream

Like kimchi, cosmetics spoil without proper refrigeration. Or so says Korean company Eupa, which markets a portable cooler that helps schoolgirls keep their hand lotions and face creams fresh by storing them at a constant 54 degrees Fahrenheit. The fridge — available with red or blue accents — uses a thermoelectric cooling system in lieu of Freon so a gal can preserve the environment along with her potions. Just don't store your lunch in there. You'd hate to have your toner smell like fermented cabbage. — **Brian Ashcraft**





Web Comic Relief

Penny Arcade Volume 1: Attack of the Bacon Robots!

► Jerry Holkins and Mike Krahulik

As geek icons go, Holkins and Krahulik rank right up there with Linus Torvalds and HAL 9000. Since 1998, the duo has been cranking out a hilarious Web comic strip that pokes fun at videogames and the people who play them. Penny Arcade gets 45 million pageviews a month and supports a thriving line of merchandise featuring beloved characters and memorable catchphrases ("Guns don't kill people. Kids who play videogames kill people"). This book collects the first two years of Webisodes and provides a peek at how the team honed its comedic chops. The comic occasionally descends into dog-whistle humor — impenetrable to normals but sidesplitting to folks who overclock their hard drives. Luckily, helpful commentary explains references to dated topics like 3Dfx cards and *Daikatana*. — **Chris Baker**

playlist

What the *Wired* gang is into this month

D2K: Jumpman Returns

What if someone wrote a splashy new chapter of *Moby Dick* or a terrific new scene of *Citizen Kane*? It happened to *Donkey Kong*. Jeff Kulczycki hacked the ROM to add challenging levels to the arcade classic.

Sins of the Fleshapoids

This jaw-dropping '60s sci-fi flick is so campy, it makes *Plan 9 From Outer Space* look like *2001*. In the future, humans relegate their work to androids. One "fleshapoid" tires of toil and decides to join his masters ... in *sin*!

Greatest Hit

The six tracks on this meta-mix were each made by smashing together the entire selection of songs from a different album. It turns everyone from the Rolling Stones to Kenny G into an eerily familiar cacophony.



THEATERS

The World's Fastest Indian

Anthony Hopkins gives a ferocious performance as New Zealander Burt Munro, the real-life biker who schlepped his Indian Scout motorcycle to Utah's Bonneville Salt Flats in the 1960s in an attempt to break the land-speed record of 200 mph. It's a sweet story of an obsessed tinkerer going balls out — with no brakes. — **Anne Thompson**



DVD

Kamikaze Girls

Based on a best-selling Japanese novel, *Kamikaze Girls* tells a story of friendship between two unlikely gal pals (one is Little Bo Peep-esque, one Goth). The film hits the mark with its neon design and slapstick humor — like a scooter-chick gangsta who ends arguments with head butts — but the gushy lessons about life are kind of a drag. — **James Lee**



We Are Scientists

► *With Love and Squalor*

This smart (and smart-alecky) trio plays hook-heavy rock that's fast, fun, and totally free-spirited. Although the band's sound isn't particularly inventive (think Franz Ferdinand meets Green Day), WAS's funky, frenetic songs are strong enough to push *With Love* to the front of the power pop pack. — **Eric Steuer**



Saint Etienne

► *Tales From Turnpike House*

This gorgeous concept album is built around a fictional London apartment complex and the day-to-day lives of its tenants. Saint Etienne's discofied club pop, lilting vocals, and playful synthesizer add color to stories of street crime, eBay's effect on thrift shopping, and what it means to be twentysomething, passionate, and a bit mad. — **Ken Taylor**



PC

City of Villains

City of Heroes streamlined the massively multiplayer online role-playing game with comic book action, but forced you to be a boring do-gooder. This sinister sister game lets you be bad — as in rob banks, kidnap wealthy heiresses, and delegate dirty work to your henchmen. Or lead a double life. Your \$15 monthly fee gives you residence in both worlds. — **Kieron Gillen**



XBOX 360

Dead or Alive 4

Tecmo's fighting series comes out swinging — and jiggling — on Xbox 360. It's visually spectacular, with sprawling environments and faster pacing. It still isn't as deep or satisfying as the *Soul Calibur* or *Virtua Fighter* franchises. But connoisseurs of virtual mammaries won't mind. The series' buxom brawlers now duke it out in hi-def. — **Evan Shamoon**

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"These are the Mercedes of headphones." – *Forbes.com*, April 18, 2005

"High-definition drivers add bonus bass and extra bite to raging guitar solos." – *Maxim*, "Top 25 of 2005," Scott Stein, May 2005

"They're pure audio nirvana." – *CNET.com*, CNET Editors' Choice, July 2005

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Big Boom Box

DOCK

Behold, an iPod sound system with the presence – and the output levels – of a baby grand. The red (or black or white) lacquer on this slick plinth goes beautifully with whichever Apple music player you dock in its crown. Two 300-watt channels drive pairs of 1-inch tweeters, 5.25-inch midranges, and 8-inch subs to give you awesome output. Also tucked into the 66-pound cabinet: a radio receiver and a slot-loader for CDs. It's loud, stylish, and much more versatile than a Steinway. Geneva Sound System XL: \$1,075, www.genevalab.com

by Brian Lam



Magic Fingers

GLOVES

Adjusting your MP3 player on the slopes used to require mashing tiny buttons with bulky gloves (*argh!*) or taking your mitts off (*brrr!*). Not so with Tavo's gadget-friendly gloves. The thumb and index-finger tips are made of nylon strands coated with silver alloy, so you can work any capacitive touch-pad (like the iPod click wheel). Go ahead, pump up the volume or change tracks – you'll be warm and in control.

Tavo Gloves: \$35, www.tavoproducts.com



Pathfinder

GPS

In downtown areas, many GPS navigation systems get blocked by skyscrapers and tunnels and lose their way. This one continues to map your progress by sensing turns with a gyroscope and tracking forward movement through your car's odometer. It also plays MP3s and receives XM satellite radio. Its gi-normous 7.5-inch touchscreen is sized for the dashboards on 18-wheelers, but we think it'll match the mammoth rims on any badass ride.

StreetPilot 7500: \$1,938, www.garmin.com



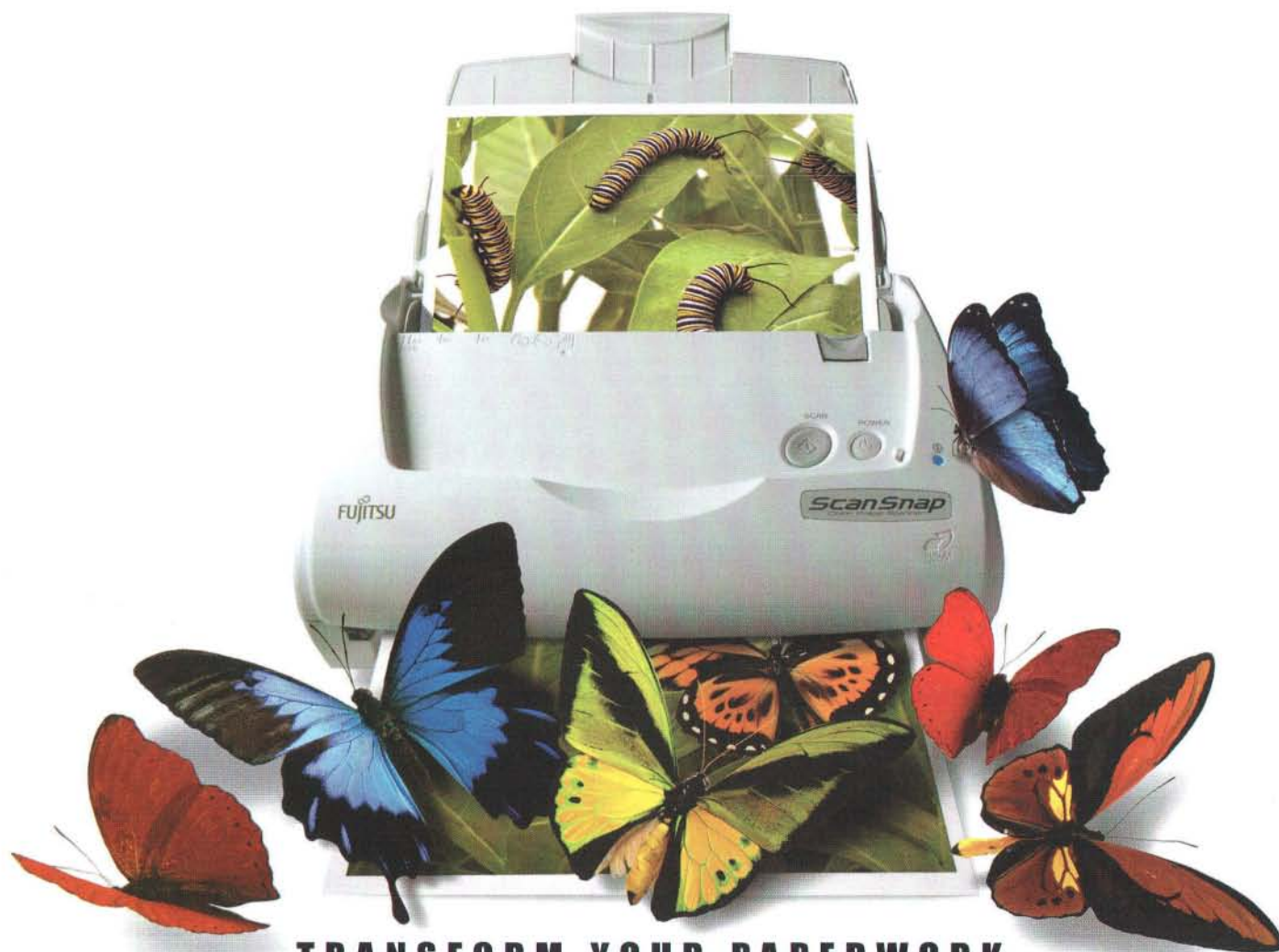
Bright Light, Big Picture

PROJECTOR

Digital home projectors crank out crisp, larger-than-life images, but ambient light can make them hard to see. Before you install blackout curtains, check out this model. Its ultrabright 400-watt pure xenon lamp resists washout. Better yet, the hi-def 1,920 x 1,080 picture is produced by liquid crystal on silicon panels. Translation: superior color range to what you get from the tiny mirrors in regular projectors. Brilliant!

VPL-VW100: \$10,000, www.sony.com

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PLAY test

SCENE SETTERS

These do-it-all devices are your ticket to cineplex grandeur with minimal fuss. Each packs a projector, a built-in disc player, and an audio system. But if you want hi-def, look elsewhere: Most have mere DVD-quality resolution (854 x 480 pixels). And the speakers are neither surround nor very loud. Still, when was the last time you set up a screening room in less than a minute? — **Seán Captain**

SIMPLE SETUP TIPS

- **Raise the projector** Ignore the feature that lets you digitally fix the “keystone” shape of an image that’s projected at an upward angle; it reduces clarity. The better fix is low tech: Raise the entire projector until the picture is square.
- **Select a screen** Sure, you can watch movies on any light-colored wall. But you’ll get higher quality from a portable screen made by Da-Lite (www.da-lite.com) or Draper (www.draperinc.com).
- **Tweak the settings** Adjust your projector for the screen and room lighting using a basic calibration DVD, such as *Sound & Vision Home Theater Tune-Up* or AVIA’s *Pro DVD*.

HOW WE TESTED

- **Calibration** We used the AVIA *Pro DVD* kit to determine the optimal image presets for watching movies at night: “Cinema” on the Optoma, “Theater” on the Epson, and “Film” on the RadioShack. (The Hasbro doesn’t offer image presets.)
- **Performance** We played a battery of challenging DVDs — *Charlotte Gray* for shadow detail and saturated colors, *Star Trek: Insurrection* for deinterlacing, *Kill Bill: Vol. 1* for sound effects, and *Standing in the Shadows of Motown* for audio quality and flesh tones.



Optoma MovieTime DV10

This projector delivers a hearty helping of eye candy, with the sharpest visuals and most accurate colors (especially evident in skin tones). The sophisticated, though somewhat clunky, controls let cinephiles tweak the picture to perfection. Plus, its steep projection angle and relatively short “throw” — from 60 inches back, it beams a 4-foot-wide image that’s 15 inches higher than the surface the unit rests on — make it ideal for coffee tables and cramped apartments. Unfortunately, the integrated 5-watt stereo system sounds a bit thin; you’ll need the optional \$199 subwoofer to add boom to your room. Or, as with the Epson and Radio Shack models, you can connect the MovieTime to a 5.1-surround system via a digital audio connection.

\$1,299, www.optomausa.com

↑ WIRED

Best overall image. Full controls on player handy if you misplace the remote. Three adjustable feet for easy leveling. Quiet cooling fan. Stylish carrying case.

↓ TIRED

Wimpy audio. Vague, poorly translated manual. Slight speckles appear in shadows.

CHEAP THRILL



Epson MovieMate 25

↑ **WIRED** Brightest projection. Shortest throw: 4-foot-wide picture from 50 inches back. Killer audio. Includes powerful subwoofer and 80-inch screen.

↓ **TIRED** Gaps between pixels cast shadows, giving images a screen door effect. Low projection angle. Dark flesh tones look a tad yellow.

\$1,199, www.epson.com



RadioShack Cinego D-1000 Instant Theater

↑ **WIRED** Accurate color. Comes with a decent subwoofer. Very compact.

↓ **TIRED** Video isn’t deinterlaced, resulting in squiggly lines and crawling pixels. Low contrast. Unimpressive stereo speakers. Chintzy remote.

\$1,300, www.radioshack.com



Hasbro's Tiger Electronics Zoombox

↑ **WIRED** Cheap. Audio doesn’t completely suck.

↓ **TIRED** Everything else completely sucks. This toy projector can barely muster a dim, 25-inch-wide image in a dark room. Pathetic 557 x 234-pixel resolution creates hopelessly grainy projections. You’d be better off buying a portable DVD player.

\$299, www.hasbro.com



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PLAY test

UNTANGLED TUNES

Tired of getting caught in your headphone cable? These cans use Bluetooth to transmit your music wirelessly. Some even support a cell phone and put your tunes on hold while you chat. — **Cathy Lu**



↑ WIRED

Rich sound. Cranks up the loudest. Embedded mike for phone calls. Good battery life: 8.3 hours.

↓ TIRED

Answering the phone means fishing for the Call button under the right earpiece.

TEN Technology naviPlay Bluetooth Stereo Headset

These headphones are designed to work only with Apple iPods. In this case, exclusivity rules: iPod owners need look no further. While the transmitters for the others we tested plug into any music player's audio jack, the naviPlay links to the iPod's dock connector, which enables the 'phones to control tracks. And, when you charge the transmitter and headset, it powers up your player, too. NaviPlay is compatible with Bluetooth-enabled phones, but not other digital audio machines.

\$199, www.tenttechnology.com

**Logitech Wireless Headphones for MP3**

↑ **WIRED** Crisp, clear audio with ample bass. Solid connection: almost no hiccups or stuttering.

↓ **TIRED** Tight fit and heft (3.2 ounces) made it uncomfortable. No cell phone connections.

\$130, www.logitech.com

**Plantronics Pulsar 590A**

↑ **WIRED** Superb 11-hour battery life. 30-foot range — 5 feet more than any other unit tested. Tons of extras: charging stand, case, audio cord.

↓ **TIRED** Stuttered every now and then. Music quality is passable but lacks detail. Expensive.

\$250, www.plantronics.com

**iOgear Bluetooth Stereo Kit**

↑ **WIRED** Universal support — works with cell phones, PCs, and music devices.

↓ **TIRED** Around-the-neck design pinched behind the ears after a few hours. Giant microphone (thankfully, detachable) screams "Telemarketer!"

\$180, www.iogear.com



STREAM ON

All audio streamers pipe music from your computer to your stereo, but few do it with such effortless style as the Squeezebox. It pulls digital audio files — nearly any format you can imagine — from across an Ethernet or Wi-Fi network. And the etched-aluminum case is super sexy. But the Squeezebox's software is what really rocks: It serves up your entire PC music collection, plus Net radio, podcasts, and RSS headlines. Because Slim open-sourced the code, geeks have built endless plug-ins to do even more. — **Paul Boutin**

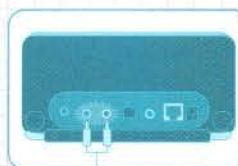
\$249 (wired), \$299 (wireless);
www.slimdevices.com

↑ WIRED

Sounds fantastic. Big, bright display. Plays all popular audio file formats, plus Net radio. Surfs iTunes and Winamp playlists. Hackable.

↓ TIRED

Won't play protected files from iTunes or other stores. Nearly as costly as a budget PC.

**Analog or digital output**

Besides digital optical and coax outputs, Squeezebox has a premium Burr-Brown converter to transform digital audio to hi-fidelity analog output.

**Fluorescent display**

LCDs? Puh-leeze. The Squeezebox screen glows a brilliant blue-green that's bright enough to read from the La-Z-Boy on a sunstruck afternoon.

**Open source software**

SlimServer handles music streaming; dozens of homebrew plug-ins let you check weather and email, control a TiVo, and even play Pac-Man.

BIRDS OF PLAY

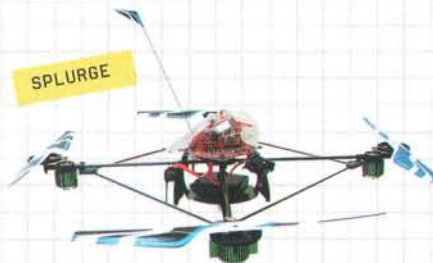
Reach for the sky with these radio-controlled helicopters. Like the real things, they're prone to crashing, but with a little practice, you'll soon earn your rotors. — Richard Baguley



Megatech Horse-fly

⬆️ **WIRED** Two counter-rotating blades eliminate the need for a squirrely rear prop, making it fairly stable. Manual explains the ABC's of helicopter piloting.
⬇️ **TIRED** 10-minute battery life cut flights short.

\$500, www.megatech.com



Draganflyer V Ti Pro

⬆️ **WIRED** Easiest to fly, thanks to gyros and infrared sensors. Videocam adds a copter's-eye view. 15-minute battery life.
⬇️ **TIRED** Price hovers higher than the chopper.

\$1,600, www.draganfly.com



GWS Mini Dragonfly

⬆️ **WIRED** Small but tough – stood up to numerous crashes without damage. 14-minute battery life.
⬇️ **TIRED** Spartan build: You turn the copter on and off by unplugging the battery. Twitchy in the air.

\$246, www.gwsus.com



JUST DRIVE IT

Early cordless screwdrivers were big and heavy – overkill for around-the-house jobs like hanging pictures. Now, with compact new designs and features like lightweight lithium-ion batteries, toolmakers are driving for your kitchen utility drawer. — Sean Cooper



Black & Decker SmartDriver

⬆️ **WIRED** Strong driving and drilling ability. Mammoth 40-piece bit set included. Lithium-ion battery.
⬇️ **TIRED** Cheap trigger housing sometimes didn't engage.

\$40, www.blackanddecker.com



Metabo PowerMaxx

⬆️ **WIRED** Drove wood screws into wall studs like hot nails into butter. Five torque and two speed settings.
⬇️ **TIRED** Pricey. Nickel-cadmium batteries lose charge when idle for long periods. Bits not included.

\$159, www.metabousa.com



Skil iXO

⬆️ **WIRED** Smallest, lightest model tested. Resilient lithium-ion battery. Solid construction and responsive controls. Two-year warranty.
⬇️ **TIRED** The 3.6-volt motor choked on heavier-duty tasks like drill-driving.

\$39, www.skil.com



Craftsman 4.8-Volt Impact Power Driver

⬆️ **WIRED** High-RPM motor made short work of small jobs.
⬇️ **TIRED** Wouldn't drive screws into wood without predrilling. Big and heavy. Lowly nickel-cadmium battery.

\$50, www.craftsman.com



shopping cart

What the *Wired* gang bought this month

1 Denon S-101 Home Entertainment System, \$999, www.usa.denon.com

Simply put, the S-101 rocks. The head unit plays DVDs, CDs, and music from my iPod mini (the menu appears on my TV screen), cranking out gorgeous sound through its twin speakers and subwoofer. The only bummer: I had to upgrade the video cable. — Rebecca Smith Hurd

2 Freedom flashlight, \$20, www.freedomflashlight.com

Monsters are an issue at our house. The only way the 2-year-old manages to keep them at bay is to sleep with a flashlight. But slapping in new AAs at 3 am gets old quick. This battery-optional torch lights up with a little shake. — Laura Moorhead

3 Burton Mission Snowboard Bindings, \$180, www.burton.com

I bought these lightweight bindings mainly for the toe strap and the quick-release buckles, but the "gas pedal" insert helps me start turns faster. I'm gonna fly. — Jeffrey M. O'Brien



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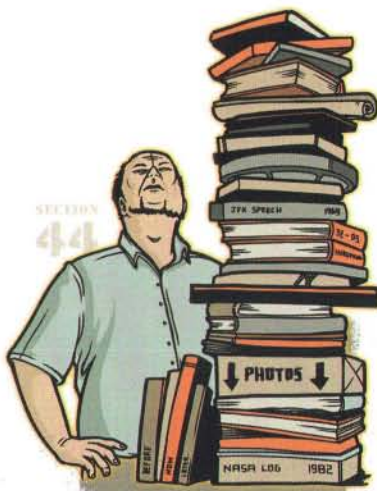
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Dispatches from the Wired frontier



NATIONAL ARCHIVES

File This Under Data Overload

As a young historian visiting the National Archives more than four decades ago, Allen Weinstein met an employee named Mr. Taylor who seemed to know the whereabouts of every document – from the Declaration of Independence to the latest Bureau of Mines report – in the entire block-long neoclassical complex. Mr. Taylor was still working there last February when Weinstein was sworn in as the ninth archivist of the United States.

Weinstein has a lot to say about the 84-year-old civil servant when I meet him in his vast office, furnished mostly in the generic colonial-federalist style favored by embassies and bed-and-breakfasts. It doesn't matter that I've come to talk about the new Electronic Records Archives project, which Lockheed-Martin will build at a cost of \$308 million over the next six years. "What are your hopes for ERA?" I ask the nation's archivist. "What are your concerns?"

"I worry about losing Mr. Taylor," he mumbles, his voice barely audible. Weinstein is a lean man with sparse white hair, a round face drawn into a pout, and a laminated ID hanging over his necktie. He clings with both hands to the padded arms of his chair. "I worry about losing Mr. Taylor's expertise and the expertise of people like him. They've been living with history."

Several rooms away, one of Weinstein's deputies, Robert Chadduck, is trying to figure out how to live with history of the digital variety. As research director of ERA, he has set up his computer laboratory in the only space he could get: the conference room of the archives' National Historical Publications and Records Commission. On the shelves surrounding his three screens are hardcover reprints of writings by Frederick Douglass and John Marshall. He doesn't appear to notice the books as he paces the room, waiting for an assistant named Mark to call up some data he wants me to see. "ERA is unprecedented for the National Archives," Chadduck says, and his voice almost breaks with pride as he informs me that "it's identified in the president's budget as a major systems acquisition."

On the monitors behind Chadduck, I watch Mark mutely arrange the images. There's a topographical map of Hawaii, a fly-through simulation of the Great Lakes, and a virtual reality model of a NASA space platform. Each is stored on disk or tape in a different location: the National Archives' College Park storage facility, the University of Maryland, the San Diego Supercomputer Center. "The challenge is to create a transcontinental, persistent archive," one that can be accessed from anywhere, at any time, Chadduck says. But his sample fails to convey the vastness of the estimated 347 petabytes of data preserved in the archives in thousands of digital formats.

The National Archives has been receiving electronic materials since 1970, but plans for long-term preservation of it all didn't



trackback

here's a thought

And Now a Few Words for Our Sponsors ...

“iPod video has been a ding moment across media. It forces advertisers to make commercials compelling enough that people don't throw out their iPods and pick up a book. Sponsors also need to add their commercials to the vlogs I'm watching now. Ad agencies are whining about measurement. Well, wake up, fools! People are watching TV online and on their iPods and you're not there with them.”

Posted on buzzmachine.com

Jeff Jarvis, media critic and columnist

Cribbed Notes

“Rep. Sherrod Brown wrote to Sen. Mike DeWine, voicing concern about Supreme Court nominee Samuel Alito's labor record. Brown's language was crisp – and was plagiarized. [Much] of what Brown ... wrote in his letter was lifted from an Internet posting by a blogger.”
Published by Cleveland's Plain Dealer
Stephen Koff, news reporter

“So a Sherrod Brown staffer used some lines from one of my blog posts. Who frigging cares? Politicians use public domain sources in a whole host of ways.”

Posted on nathannewman.org

Nathan Newman, labor lawyer/activist

POSTS

begin until 1998. And the government has only started to take it seriously in the past three years. "Isn't that a bit late?" I ask Chadduck. "I won't presume to speak for the White House," he replies testily. He directs my attention elsewhere, handing me a small poster cluttered with more logos than a stock car. There are insignias for the Library of Congress, the National Science Foundation, the Department of State, and the National Nuclear Security Administration, among others, each indicating a research partnership that the National Archives has recently established. These entities have been grappling with digital preservation for a while, and Chadduck hopes to benefit from their efforts. "We don't want to reinvent the wheel," he says.

So ERA will be a modular system, relying as much as possible on technologies (many of them open source) developed elsewhere. For example, one anticipated module will be responsible for determining what kind of software was used to create an incoming document. Another will translate it into a usable format. Others will handle distribution, backup, and searchability. The modules can be replaced or added as technology advances – there would never be a need to reengineer the entire system. Another boon, at least from a bureaucratic standpoint, is that nobody has to define the limits of what the system will actually do.

Of course, no matter how the system evolves between now and 2011, one module it won't encompass is Mr. Taylor. While Lockheed's design prototype emphasizes intuitive access for users ranging from amateur genealogists to career paper pushers, no software on the market today or in the future is likely to have the veteran archivist's idiosyncratic expertise, his intuitive grasp of the collection's contents.

Mr. Taylor is elusive these days. He hides in the stacks whenever Weinstein shuffles by. "He's afraid that the archivist is trying to retire him," explains Miriam Kleiman, another Taylor protégé. "Retire him?" Weinstein counters, enunciating his words for the first time since I've met him. "I want him to work 40 more hours a week."

He sighs. Weinstein has just been given the largest appropriation in National Archives history, for a system that will be the envy of every library around the world,

but I see that it doesn't satisfy him in the least. "What happens next, I'm not sure, just not sure," he mutters.

The archivist of the United States looks down at the floor. What he really needs, no technology can provide. – **Jonathon Keats**



SATELLITE TV

A Big Turn-On for the Turks

Mustafa Özgen's borrowed Ford Turbo bumps along a Turkish dirt road, 13 miles from the border with Syria. Özgen rumbles past dilapidated houses, abandoned during the country's prolonged war with Kurdish separatists. In the back of his truck, satellite TV dishes are stacked neatly on their sides like silverware in a drawer. Özgen, a Kurd, is making the three-and-a-half-hour journey to the village of Kocyigit. But he doesn't use its Turkish name; he insists on the Kurdish appellation, Roşat. Feelings are still a bit raw in southeastern Turkey.

A man wearing an oversize sports coat watches intently as Özgen's truck approaches. He has walked for hours to reach Roşat. When Özgen finally arrives, the man waves him to a halt. "I can't get Animal Planet," he says. "What's the new code? My kids are driving me crazy." Özgen leans out the window to give him two 16-digit codes. After a quick handshake, the man begins the long walk back to his village. "Sometimes they change the codes for channels so people can't watch them without a subscription," Özgen says later. "But I can always find them on the Internet."

Özgen, a door-to-door satellite TV salesman, is part of a new crop of entre-

preneurs taking advantage of the repopulation of the Turkish countryside. In the process, he has become an unlikely ambassador of culture; the 35-year-old sees his work as more of a humanitarian effort than a capitalist venture. Until a few years ago, this delivery trip would have been illegal – Turkish military routinely destroyed dishes to keep the Kurds from watching TV in their own language. "Men here have gone through the military service and school. They know Turkish," Özgen explains. "But most women speak only Kurdish. They need Kurdish satellite TV." Imagine the Muslim women of Roşat, covered in full-length dresses that tie at the ankle, faces veiled in thin cotton scarves, kicking back with Animal Planet.

Of the 900 channels that Özgen's service beams in from northern Europe, five are broadcast in Kurdish, offering news, talk shows, and US documentaries. Roj TV is the most popular station in the region. It broadcasts in Kurmanji, the Kurdish dialect spoken there, and it is sometimes more reliable than Turkish news, especially on touchy topics like separatist movements that might otherwise go unreported.

Özgen pulls up to Yilmaz Acar's house. Before he cuts the engine, Acar's wife ducks inside. She returns with glasses of *ayran* (chilled diluted yogurt) and then disappears, as is the custom, until her husband has finished his business. Acar's place doesn't have a roof or windows, but he's willing to put off the purchase of those to buy a satellite dish. He makes just \$260 a month from his small grocery store; it will take about a year to pay Özgen's \$180 fee on the installment plan. Before today, he plugged his TV into his neighbor's satellite system. But, he says, he's tired of watching his friend channel surf.

In front of another house, Özgen grabs his leather bag and pulls out an access card. This is a special order. News isn't the only thing being beamed from Europe; pornography is, too. Özgen walks up to the front door and furtively slips the card to a middle-aged man, who quickly takes it and shuts the door. Some situations are delicate, and customers would rather not talk at length about their preferences. "People ask for things from a satellite salesman they wouldn't tell anyone else," he says. "I'm like a doctor." – **Thomas Galen Grove**



SPORTS FUTURES

The Ticket Option Market

With 46 seconds left in last season's Super Bowl, the Philadelphia Eagles still had a chance: A field goal would tie the game, a touchdown would win it. On the third play of the possession, quarterback Donovan McNabb rifled the ball downfield – right into the hands of New England Patriots safety Rodney Harrison. The contest ended, and die-hard Eagles fans were heartbroken. But for two of them, a new game was about to begin.

Late the next night, Brad Simmons left the warmth and poky dialup modem of his Philadelphia apartment and walked 20 minutes through a frigid February evening to his office and its high-speed Internet connection. Meanwhile, in Crofton, Maryland, Brad's older brother, Paul, was seated at his home computer and already connected to the Web via high-speed access.

Both had their browsers pointed to an online futures market for Super Bowl tickets. Fans purchase options in the hope that their team will be in the championship. The Simmons siblings were confident the Eagles would make it to the Super Bowl again next year, and they had a simple strategy: buy, buy, buy.

The market opened at midnight, and the brothers jumped right in. After a few minutes, with the option price at \$150, Paul spent \$1,200 for the right to buy eight standard tickets to the 2006 Super Bowl (if the Eagles make it). Meanwhile, Brad, who was only just getting warm after his walk, didn't fare so well. The site couldn't handle

the heavy traffic and stalled as he tried to join the frenzied buyers – prospective Eagles seats sold out in minutes. Brad had little choice but to try an end around. He bought options for all the teams that he thought Philadelphia might play in the next Super Bowl.

The Simmons brothers purchased these options, or Fan Forwards, at Ticket Reserve. The Chicago-based company offers sports-lovers the opportunity to buy seats at face value to everything from Nascar Daytona 500 races to NBA playoff games – events that are often accessible only to people willing to hand their life savings to scalpers. So, if the football team you've bought an option on makes it to the big game, you will be able to buy tickets for between \$500 and \$600 each. Add in a couple hundred dollars for the options and the total cost per seat will still be much less than the \$3,000 a scalper would charge on game day. Of course, if your team doesn't make it, your ticket options are worthless – you get the right to watch the kickoff from your living room couch, no matter how much you paid.

Opening prices for ticket options are set by the company based on a team's likelihood of success. Once an option is purchased, it can be traded as the season progresses, with Ticket Reserve taking a 7 to 10 percent cut on every transaction. If a fan holds Forwards for a team that gets knocked out of the running, he forfeits his money. As soon as the teams in the big event are determined, the market closes and everyone with eligible Forwards is charged face value for the tickets.

The company can guarantee seats because of its partnerships with leagues, teams, and hospitality providers that sell ticket packages. In return, sellers get the full price of the tickets, a percentage of the Fan Forward opening price, and a percentage of fees earned by Ticket Reserve for all subsequent trades involving those tickets.

The system works much like futures markets for stocks or frozen pork bellies, with one big difference: The customers have emotional investments in what they're buying. Chicago resident Vincent Schideman bought options to watch his hometown Bears play in the Super Bowl – an unlikely scenario when he bought the options that became much more plausible as the season progressed – though he didn't have much luck with his Forwards for the Cubs. "I always bet with my heart, never with my mind," Schideman admits.

Paul Simmons, meanwhile, bets with both. The same day he bought his eight ticket options for \$150 each, he sold two for \$580 a pop. Then, as the team slumped in the middle of the season, he dumped the rest of his Forwards, selling two for \$300 and four for \$200 after a dispiriting loss to the Washington Redskins. But he hasn't given up all hope; he's just put money into the teams that might play the Eagles in the Super Bowl. If his hometown team recovers and makes it to the big game, he's definitely going with his brother.

If the Eagles continue to flounder, he might just deal away his other futures. He won't get to live his dream, but at least he'll make a few more bucks. – Erin Biba



Neoncity, by Matt Pyke.



When Theft Serves Art

BY LAWRENCE LESSIG

Andy Warhol was an artist. He was also a businessman. As he famously quipped, "Being good in business is the most fascinating kind of art." Warhol was great at both.

But Warhol's art was of a particular sort. *Appropriationist* is what some call it, as if there is art that doesn't draw from the culture around us. *Remix* might be a less charged moniker. Warhol created work that appropriated and remixed. Some of that culture was owned, meaning copyrighted or trademarked (think Campbell's soup cans). Some wasn't. But whether owned or not, the result was distinctly Warhol. He freely built on work that came before him.

When he died in 1987, his will called for setting up a foundation to manage his estate. From the beginning, that foundation faced an obvious question: What should it do when others used Warhol's images?

The artist didn't leave much of an answer. He directed his executor to

establish a "foundation for the advancement of the visual arts" and named three people to start the organization. But the Andy Warhol Foundation for the Visual Arts had to define its own mission and, more important, the values it would stand for. Would it exercise the control the law gives it over Warhol's art to maximize its income? Or would it exercise that control the way Warhol practiced his art?

I've grown so cynical about these copyright and culture debates that I wouldn't have thought an organization in the Warhol Foundation's position would even ask such questions. Of course it would exercise its right to maximize control. Rabid intellectual property protectionism – IP extremism – is so rampant that if the foundation demanded that future Warhols pay for permission to build on Warhol's art, most people wouldn't even notice the hypocrisy.

So I was surprised to hear the foundation's president, Joel Wachs, describe its values to an audience of New York City bar association members gathered to learn about fair use. The Warhol Foundation is "vigorous in enforcing our rights when it comes to people wanting to use Warhol's art for commercial purposes," Wachs said. But when it comes to artists and scholars, the rules are very different. "We permit artists to use and reference Warhol work without charge and without challenge." And "we let scholars use

from images that build on Warhol's, but the foundation doesn't even ask to see how his work will be used. To condition the freedom of scholars or artists to use Warhol's pieces upon such a review would be censorship, Wachs explained. And the foundation has learned that there are people on both the right and the left who are keen to engage in just this sort of censorship.

Compare this with the practice of major film studios, as reported in J. D. Lasica's book *Darknet: Hollywood's War Against the Digital Generation*. Lasica asked to use small clips from famous films in some home movies he wanted to make – footage he promised would never be shown to anyone outside of his friends and family.

Universal Studios told Lasica he would be "obligated to pay ... \$900 for each 15 seconds." When he asked for two 10-second clips from a Daffy Duck movie, Warner Bros. said, "We do not ... allow our material to be edited or altered in any way." And the Walt Disney Company told Lasica it "had to establish a general policy" of – you guessed it – saying no. In Disney's view, no one – not even artists, not even noncommercially – is free to build on Disney the way Walt Disney built on the Brothers Grimm.

There's not much hope that Congress will begin to think sensibly about the IP extremism its laws encourage. But we'd achieve a great deal if copyright

Your 15 minutes are free. But 15 seconds of Universal's film footage will cost you \$900.

Warhol imagery for just a nominal fee to cover the cost of administering the rights." Wachs told me later, "We're Lessig when it comes to artists and scholars" and "Disney when it comes to commercial use."

To people who live outside the IP-extremist culture, this sounds quite sensible. But inside that culture, the foundation's values are incomprehensible. Not only are artists free to create and profit

holders – and those who challenge them – started speaking and acting with a Warhol sensibility.

As a former Los Angeles city councilman and mayoral candidate, Wachs knows well the arguments of the extremes. He and his foundation do creators and creativity a great service by resisting the demands of the extremes and practicing the values by which Warhol lived.

Email lawrence_lessig@wiredmag.com.

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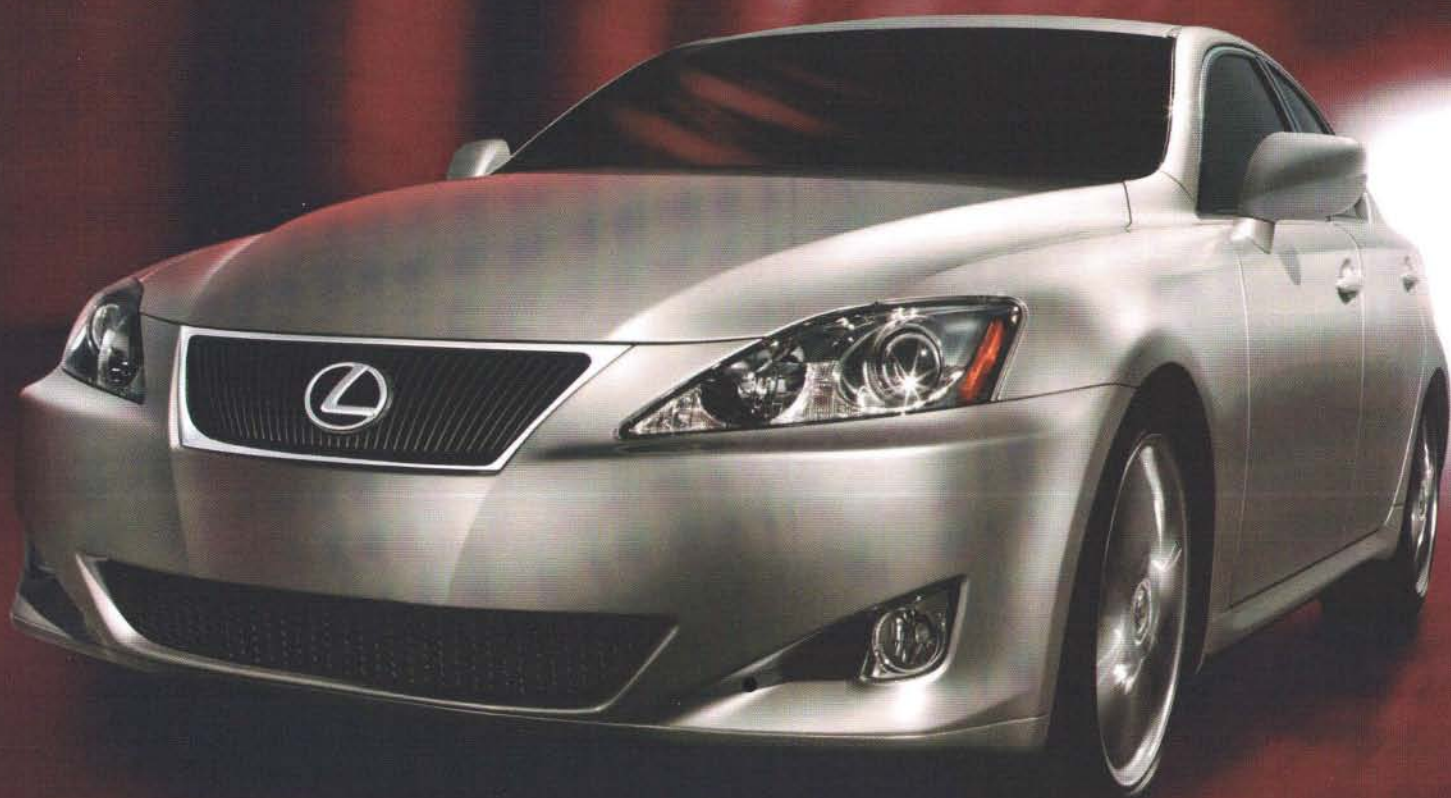
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HOW PREFAB GOT COOL

INSIDE: THE MODULAR BOOM ♦ 6 COOL TECH INTERIORS ♦ 4 D.I.Y. UPGRADES



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SOME ASSEMBLY REQUIRED

A new generation of tech-savvy architects is bringing premium-quality, prefabricated housing to the masses.

by Tom Vanderbilt

At the Britco factory in Agassiz, British Columbia, a few hours east of Vancouver at the mist-enshrouded foot of the Cascade Range, they build houses a little differently. Plumbers, electricians, and roofers don't come to the house. The house, rolling down an assembly line on casters, comes to them.

Inside a cavernous hangar where the pneumatic *thwack! thwack! thwack!* of nail guns mixes with the drone of jigsaws, Britco produces as many as 600 modular structures a year – everything from houses and banks to classrooms and McDonald's restaurants. The company calls them "factory-built buildings." Brochures in the lobby suggest a take-out-pizza approach to construction: "Need Space Fast?" and "We Deliver Anywhere."

The job that's now moving down the 23-station line, director of sales Mike Ridley



The Breezhouse, designed by Michelle Kaufmann (right), features an open center area to cool the space without air-conditioning.

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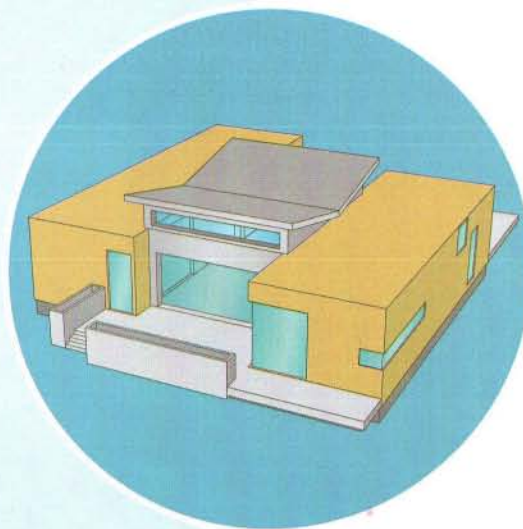
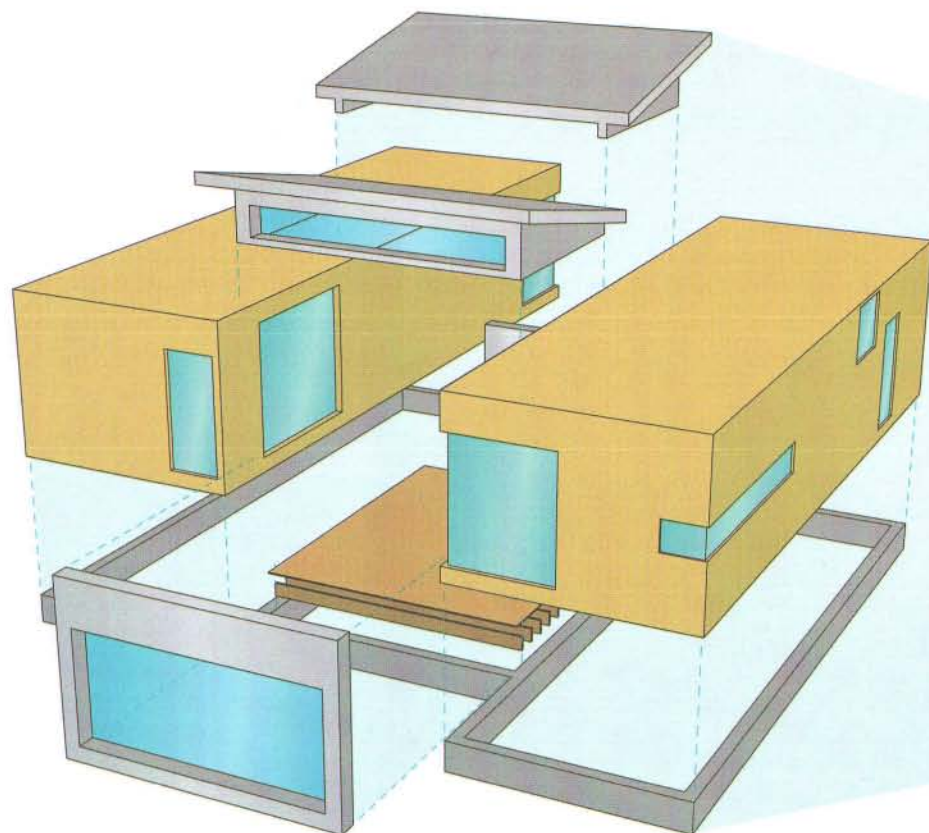
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A Breezehouse is made up of seven main prefabricated parts. A stick-built home of similar size can have as many as 70 components.

explains to me as we watch hard-hatted workers stuff insulation between joists, is a series of eight-room structures that will house 49 workers each. Destination: the tar-sands region of Alberta, Canada, where oil riggers will live in these cheap, portable dwellings for several months before both men and modular buildings head to the next job.

Watching the houses move down the line with us is Michelle Kaufmann, an architect from San Francisco. A leading light of the prefab movement, Kaufmann, 37, is here to strategize with Britco execs about increasing production of her Glidehouse, a sleekly modern metal-sided, bamboo-floored, glass-fronted, energy-efficient modular dwelling named for the gliding doors that conceal the interior's flexible storage spaces. As we walk the Britco floor, she points toward a winch hoisting a wood panel into place atop a

camp building. "Look, here comes a ceiling," she says, clearly thrilled.

Prefabricated construction is a term for parts of buildings that are manufactured off-site, from roof sections to entire multi-room dwellings, in standard sizes and shipped for assembly elsewhere. Of course, that's not really new – back in 1906, the Aladdin Company was dropping factory-made Read-Cut house kits in the US mail. One hundred years later, technology is helping architects team up with factory managers to create striking modern houses built to the same codes as homes constructed on-site, for less money and in less time.

Kaufmann had been working on traditional commercial projects for 10 years before she became a prefab devotee in winter 2002. She and her husband were looking for a house in the San Francisco Bay Area, and for months, they spent their

Sunday afternoons wandering through million-dollar fixer-uppers. These homes weren't just too expensive; they lacked the modern aesthetic and built-in green features Kaufmann wanted. So the couple bought some land north of the city and constructed what she calls a "sustainable box." It was the first Glidehouse. Soon, friends started asking if she could do the same – exactly the same – for them. Kaufmann went to prefab construction builders, most of whom demurred or tried to sell her some faux châteaux. But Britco was willing to stray from its line of low-end prefabs, and the results were startling. Kaufmann and her husband spent more than seven months and \$300,000 building their home. Now Britco can crank out a Glidehouse in 24 days, for \$210,000. (Final walk-in-the-door price, which includes permits, delivery, and foundation work, can be another

\$100,000. On top of that, of course, is the cost of the land.)

Ten Glidehouses now dot the West Coast, from California to the Canadian border, and Kaufmann has another 55 clients ready to build. Two have commissioned modular town house developments in Colorado and California (boosting the number of Glidehouses in the ground or on the drawing board to more than 100). Plus, there are 25 more orders for another Kaufmann prefab project, the Breezehouse.

Prefab can be a dirty word, suggesting temporary disaster-zone structures and the Shady Lane Trailer Park. Kaufmann, who trained for five years with Frank Gehry before starting her own firm, wants to ditch the downscale connotation by bringing quality, customization, and craftsmanship to factory-built homes. Modern prefabs, she believes, can be more Mies than mobile home.

The prefab trend is already getting some attention in museum circles. In May, Kaufmann's Glidehouse will be featured in an exhibition at the National Building Museum in Washington, DC. Her Breezhouse is currently on display in an architecture show at the Walker Art Center in Minneapolis.

The question now is whether Kaufmann can break into the subdivisions of Middle America. She's not the only one trying. Other architects are embracing this vision of mass customization. Charlie Lazor, a founder of the iconic Blu Dot furniture company, recently left to start his own concern selling FlatPak houses. Los Angeles-based architecture firm Marmol Radziner + Associates just opened a 64,000-square-foot factory to fabricate the steel frames for its new prefab line. And renowned LA architect Ray Kappe has designed a model for a prefab venture started by former dot-com mogul Steve Glenn.

For the past century, the idea that a factory could produce a house more efficiently and cheaply than carpenters has been a recurring dream – what Lazor calls “the holy grail of modernism.” In the 1930s, Bau-

haus founder Walter Gropius pushed his vision of prefab, a packaged house that arrives at your lot, and he was hardly alone. Architectural historian Colin Davies notes that by the end of World War II, there were more than 200,000 prefab

The whole thing, in shrink-wrap, fits on the back of one or two 14-foot-wide tractor-trailers.

homes in place, made by more than 70 companies. At mid-century, the American landscape was filled with prefab, from the kit abodes sold by Sears' Modern Home department to Buckminster Fuller's geodesic domes to the steel-paneled Lustron homes created by – you guessed it – a manufacturer of steel paneling. Even today, luxury developers like Toll Brothers ship entire sections of semicustom homes to building sites.

Nevertheless, modern prefab homes are still seen more in magazines than in neighborhoods. “It's more of an idea than a market reality right now,”

says Michael Sylvester, founder of the Web site Fabprefab.com.

But that's changing. In overheated real estate markets, people are turning to prefab as a reasonable alternative to mass-market tract housing or expensive custom-designed homes. Avi Friedman, an architecture professor at McGill University, estimates that 5 to 10 percent of all new homes in North America are prefab (and about 10 percent of that market is upscale). He predicts the prefab figure will jump to more than 35 percent in the next 10 years. The future can already be seen in places like Sweden, where more than 70 percent of new housing is prefab (including Ikea's BoKlok line), or Japan, where prefabricated homes made by subsidiaries of Toyota and Panasonic are considered premium residences. “They have factory lines there with robots building wall panels. They put together housing components with the tolerance of Lexus automobiles, where the panels match perfectly,” says Sylvester.

The benefits of prefab building are hard to ignore. For starters, it eliminates much of the uncertainty surrounding what proponents call stick-built

homes. Construction happens indoors, so there's never weather-related delay or damage. Manufacturers trim costs by ordering in bulk, and unused materials are kept for later use (some studies say construction materials account for nearly a third of landfill waste). Houses are typically built on a flat surface, which ensures a truly plumb structure. That also keeps the crew off high ladders, so workers' comp claims are lower.

All this streamlines the process, commoditizing architecture and turning the house into a product with economies of scale and standardized design processes that make for savings in time and cost. High-end modern houses in the LA area run \$350 to \$400 per square foot, while prefab dwellings hover at about \$200 per square foot. A traditional home might take more than a year to build, but a prefab is typically finished in less than a month.

Sarah Haynes turned to Kaufmann after an architect's plans for her property on Puget Sound came in at five times over her budget. “It just brought to my attention how difficult it is to build in the traditional way,”



Doors inside the Glidehouse slide back to reveal flexible storage spaces.

Pioneer *sound.vision.soul*



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she says. Haynes, a nuclear physicist, ordered a customized Glidehouse. "If you're going to buy a car," she says, "you don't buy the leather for your interior and the four wheels and a steering wheel separately. Prefab has a bad connotation, and that's unfair in this day and age."

Bad indeed. There's so much emotional resistance to prefab construction that advocates spend as much time teaching as designing. Lesson one: Modular housing is not shoddy manufactured housing. "There's still this preconception that modular is substandard," Kaufmann says. Where manufactured housing – primarily mobile homes and emergency shelters – are built to what she calls a substandard code ("using things like two-by-three framing"), modular houses are built to the same code as site-built properties. In fact, she argues, modular structures, because they need to survive shipping, are even stronger than stick-built houses – the joists, for example, are joined not just with nails but with glue and nails. "There's up to 20 percent more structural lumber used," Britco's Ridley says. Call today's prefab the bionic house: better, stronger, faster.

Nevertheless, the stigma of manufactured housing bedevils the builders of modular structures. Some municipalities zone against it; some contractors think it's beneath them. A daunting array of local building codes in the US complicates distribution models – a house built in one state might not fly in another. As Lloyd Alter, who markets modern prefab for the Toronto-based builder Royal Homes, said at the Prefab Now conference in October, "New York state is 22 miles away, but I can't sell a house there."

Banks and other lending institutions sometimes get queasy

3 Steps to Modular Living



Selection: Online tools allow home buyers to choose materials, roof styles, and floor plan.



Assembly: Factory workers put the house together on a production line. It typically takes about 25 days for a prefab to go from pile of lumber or steel to finished product.



Delivery: The home, shrink-wrapped for protection and configured to fit on the bed of a semi, arrives. Transportation cost: \$5,000 to \$30,000, not including tips.

about prefab as well. "There would probably be confusion about the process," says Andrew Reid, a branch manager at Countrywide Home Loans who specializes in financing Kaufmann's homes. The lending structure and timetable are different because prefabs aren't considered traditional homes. As a result, prefab home buyers have historically had to resort to second-tier mortgage companies with high interest rates.

The proselytizing energy of prefab proponents is helping to break down such barriers. So are the houses themselves, which draw huge crowds at home shows, not because they're modular but – thanks to their built-in green options and modern aesthetic – because they're desirable. As with the market for hybrid cars, the first wave of hardcore prefab early adopters is giving way to a larger group that now feels comfortable going modular. Sure, they love the rational benefits, but in the end a house is a home, and the Glidehouse just seems so livable. "The intangible part," Haynes says, "is how humans feel comfortable in them, with their dimensions, color, texture, ceiling height."

Buying a house, Kaufmann says, should be like buying a sneaker. On her Vaio laptop she pulls up the site for Nike iD, which lets people design their own shoes by choosing from a palette of options for lacing, fabric, and so forth. "Every shoe has the same bones," she says, showing me the record of the Nike Free she bought the previous week, "but you can customize your own, down to the color and putting your initials on it."

To Kaufmann, the question is obvious: "How can we do this for architecture?" Giving people a new kind of home requires

becoming a new kind of architect. "I spent five years in Frank Gehry's office," she says. "I worked on three projects over those five years." Now she's in a high-volume, low-margin business. "We have to be strategic with our time." Translation: no two-hour meetings about doorknobs.

Architects like Kaufmann are trying to function as a hybrid of production home builder and small architecture studio. They're using two very different kinds of software: CAD (computer-aided design) and CRM (customer relationship management). It's a balancing act, trying to make people feel as if they're getting a house that was made for them while making that house for enough people to be profitable.

This is the essential tension in prefab: how to mass-produce something that people take very personally. Technology is making possible "standardized customization," says Joel Turkel, a designer at prefab builder Empyrean International and a lecturer in architecture at MIT. As CAD becomes more sophisticated and syncs with computerized milling machines, Turkel says, the end product will become less important than the digital model itself. "The widget is not the house you're building but the script that you're writing," he says. As a buyer asks to increase the size of a standardized room, for example, "the script that creates that entity knows that every time it passes a 16-inch increment it has to add another stud. There are rules written into the script that allow a thing to grow and change but produce a standard cut list. The script is the thing that essentially makes customization a standard process."

Prefab just might be the perfect housing for an age of iPod. 094

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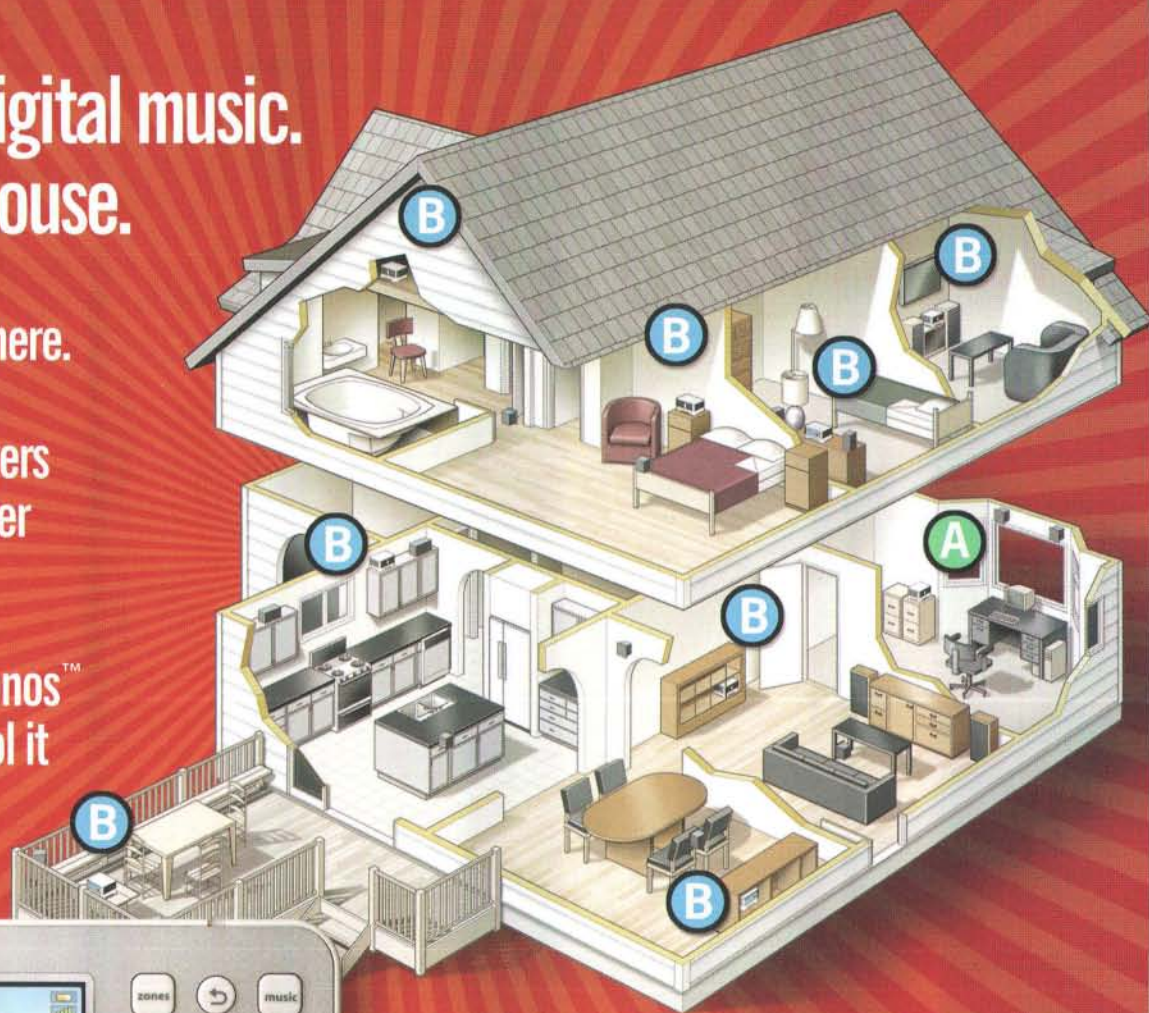
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Nick Millington, Director
of Software Development
at Sonos

Defying Wireless Conventions

From antenna to application, Sonos™ works to get wireless right.

In an interview with Nick Millington, Director of Software Development at Sonos, we learned how his team designed Sonosnet™, the wireless mesh network behind the Sonos™ Digital Music System.

What drove your decisions around the wireless network?

Nick: We had three key goals for implementing our wireless solution: extensive coverage, easy set up and reliability. The Sonos Digital Music System is designed to play music all over your house, so we needed our wireless network to work all over the house. And because we were creating a consumer electronics product not a network device, setting it up needed to be simple. Unlike most other wireless networks, Sonos automatically generates WEP keys and SSIDs so you don't have to. And lastly, we knew we'd only be successful if playing digital music across the wireless network was as reliable as your analog stereo.

Why did you choose a wireless mesh network over the more conventional access point model?

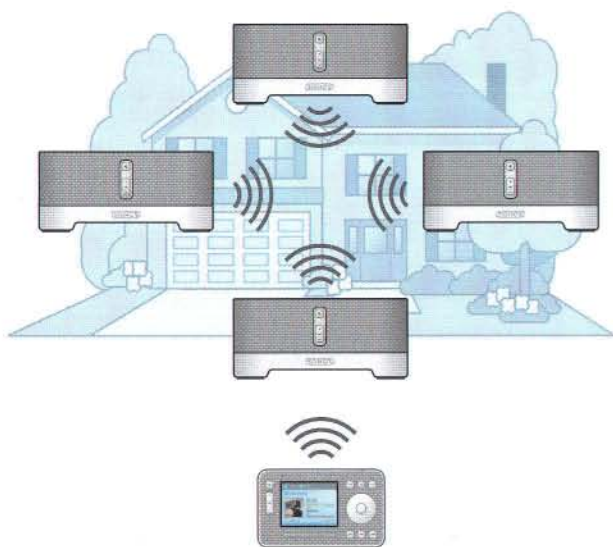
Nick: A traditional access point system with a central hub relaying all the traffic didn't give us the range of coverage we needed for an entire home, nor the performance. When you're dealing with synchronized digital music playback, you don't want to worry about dead spots or low signal strength. As long as each ZonePlayer is in range of one of the others, Sonosnet can figure out how to get the music from your PC or Mac to the rooms where you want to enjoy it. Controllers are handed off transparently from one ZonePlayer to the next, so you can control the whole system from anywhere. As far as I know, no other home entertainment product uses a wireless mesh network in this way.

What specific software features did you incorporate into Sonosnet?

Nick: There are three things I'm most proud of. Our setup technology searches for the wireless channel with the least interference rather than just picking the standard. We designed a mesh networking stack to automatically optimize the data path, so you hear the music without interruption. And we incorporated multi-casting support so we can deliver the same song to multiple rooms efficiently.

What about hardware?

Nick: At Sonos, we believe that it's often the little things that make the biggest difference – even if the customer can't see them. For instance, when we designed the antennae for the Controller we accounted for where your hands would be while operating it, and made sure the antennae would operate at maximum efficiency under these real world conditions. Plus, each ZonePlayer and Controller is individually tested on the manufacturing line to verify that it can send and receive with the expected signal strength. This all translates into the best possible wireless range and performance.



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Architect: Resolution 4: Architecture
(New York City)

Number built: 3 (4 more in contract)

Cost: \$175-250 per square foot

Wired factor: Geometric modules allow dozens of layout variations.

**weeHOUSE**

Architect: Alchemy Architects
(St. Paul, Minnesota)

Number built: 6 (8 more under contract)

Cost: \$125-200 per square foot

Wired factor: Modules can be stacked to break out of ranch house monotony.



6 SLICES OF PREFAB PARADISE

LV HOME

Architect: Rocio Romero
(Perryville, Missouri)

Number built: 13 (13 more under contract)

Cost: From \$120 per square foot

Wired factor: DIY option with 24/7 construction hotline lets owner self-assemble unit.

**TAKE HOME**

Architect: Jennifer Siegal (Los Angeles)

Number built: 3

Cost: From \$200 per square foot

Wired factor: Features iPort system for built-in iPod compatibility.

**LØVETANN HOUSE**

Architect: Snøhetta (Oslo, Norway)

Number built: 1 (20 begin construction by January)

Cost: \$190-280 per square foot

Wired factor: Built-in Siemens home entertainment center.

**MARMOL RADZINER PREFAB**

Architect: Marmol Radziner + Associates
(Los Angeles)

Number built: 1

Cost: \$190-282 per square foot

Wired factor: Use online tool to build and price the prefab.



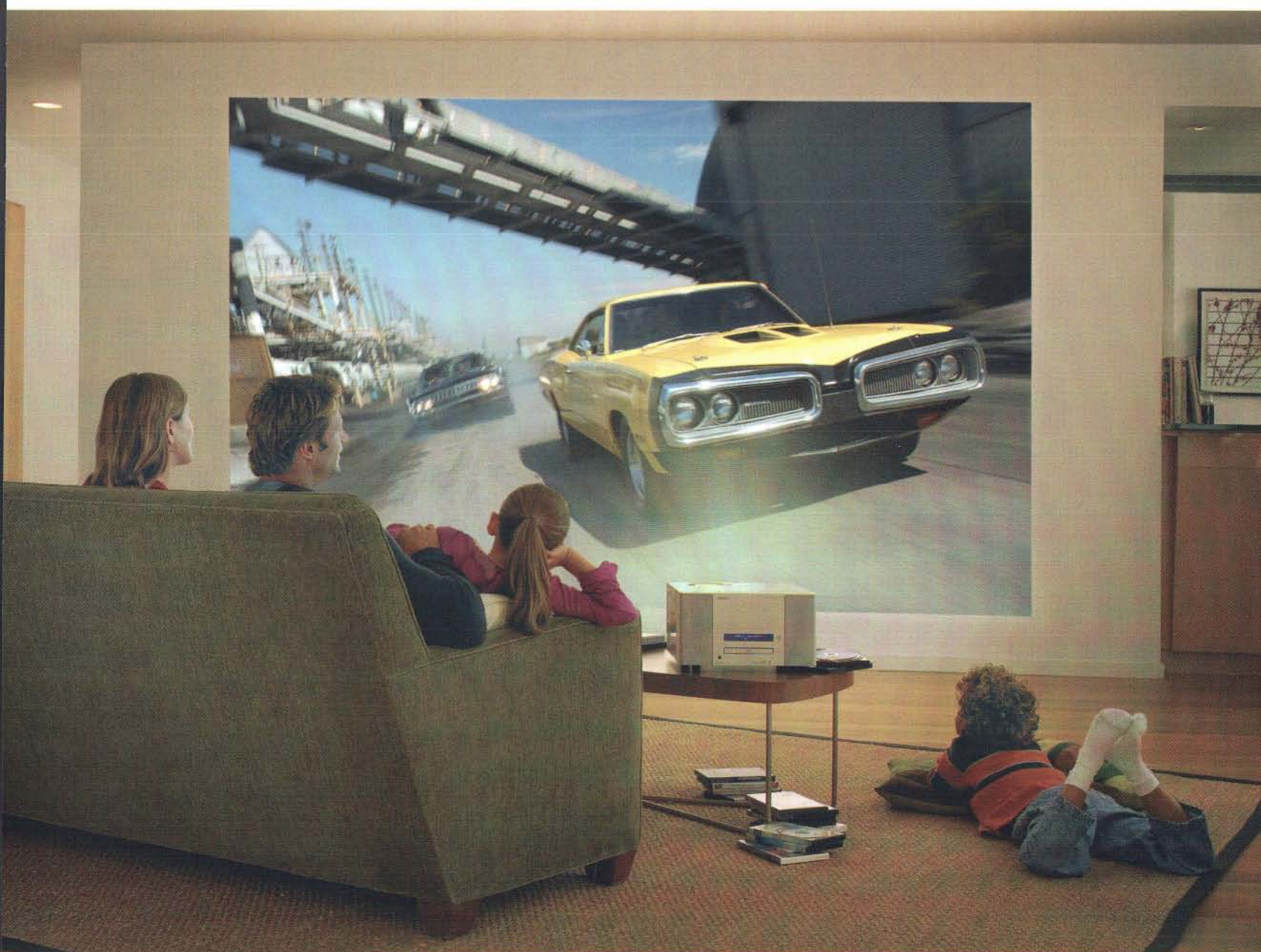
◀088 playlists and TiVo preferences and one-click ordering, where on-demand customization is becoming the norm. Sure, something similar happens in new housing developments, but the main difference is that with modern prefabs you don't have to live surrounded by serial replicas of your own home.

As with the Nike shoes, you still need to factor in shipping. Most prefab projects are constrained by what will fit on a 14-foot-wide tractor-trailer. No wonder prefab projects tend to skew smaller. "You add about 40 percent to the shipping cost just by adding a foot and a half in width," says Warner. (A 1,600-square-foot Glidehouse costs \$30,000 to shrink-wrap and ship roughly 1,000 miles.) "An extra foot and a half is important from a spatial point of view, but it has implications in terms of cost and maneuvering."

Indeed, delivery is one of the trickiest aspects of prefab. "Pilot cars" are required for the over-size loads; certain bridges are off-limits; routes are dictated by each state's transportation office. Kaufmann's driver will ask "Are you going up a hill? Because the tail might bottom out." A test run is key to ensure the house can make it to the site. "He'll only do these in his own truck, because he knows from that height just where things are."

Long after your new modular house has been welcomed home, there's just one more thing to consider: When it's time to sell, you're not obligated to divulge that it came off an assembly line. "Unless you're like me," says Kaufmann, beaming with pride, "and you say, yes, yes, it was built in a factory." ■ ■ ■

Tom Vanderbilt (tvanderbilt@nyc.rr.com) wrote about digital art in issue 13.09.



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LIVING ROOM NORTHFIELD, ILLINOIS

When it was time for architect Thomas Roszak to design his own home, he opted for minimalism in everything but technology. With features like flat-panel speakers and remotely controlled, built-in amenities — including motorized blinds, lighting, and indoor-outdoor thermostats — there's nothing to distract from Roszak's free-flowing floor plan.

— Steven Castle



1 A Siedle security camera and intercom at the front door notifies the Roszak family when someone rings the doorbell. A full-screen image of the visitor interrupts whatever is playing on the family's 63-inch Fujitsu plasma screen. If no one answers, the setup can patch the visitor through to voicemail.

2 A system of Crestron remotes lets the Roszaks control and automate the electronics throughout the home. For instance, if sensors detect that the temperature outside has dropped below freezing, a boiler heats the water in tubes under the driveway to melt snow and ice.





3 An Apple PowerBook stays wirelessly connected to the Internet via Wi-Fi, thanks to one of four AirPorts scattered about the steel, glass, and concrete home.

4 Flat-panel Jamo speakers in nine areas of the house deliver music from a central entertainment system.

5 Narrow steel beams, hidden from view in the photo, do more with less to hold up over half the weight of the loft upstairs: A soldering technique called full penetration makes the joints 150 percent stronger than a typical weld.



6 A closet hides a 660-watt Yamaha audio processor, multichannel SpeakerCraft amps, a DVD player, a 400-disc CD changer, an Escient music manager, two HDTV receivers, a video router, and a 32-bit Crestron processor.

7 Temperature and humidity sensors throughout the house control four heating and cooling systems, plus in-floor radiant heat. The sensors automatically adjust the interior climate in 11 zones, each serviced by its own thermostat.

8 Levolux motorized blinds for 8,500 square feet of glass ascend, descend, and pivot open and closed with a handheld remote.

Architect: Thomas Roszak
System Integrator: Baumeister Electronic Architects



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1 Incandescent lighting by Howard Brandston, who brightened the Statue of Liberty as part of a 1986 face-lift, creates a shadow-free work area for McDonough's wife, a chef. The recessed lighting and frosted-glass lamps ensure even light distribution.

2 Autoclaved aerated concrete is just as sturdy, provides 10 times the insulation, and weighs a fraction of the standard mix used for walls. It's also completely recyclable and naturally termite and fire resistant.



KITCHEN

STONE RIDGE, NEW YORK

Tucked deep in the woods, the so-called e-House keeps its tech on the down low. The 2,200-square-foot project was started five years ago by a dozen engineers and scientists who envisioned a high-performance, Web site-controlled building. Their experiment is now a live-work space for the renowned architect Michael McDonough, who designed the interior with energy conservation in mind. As the home's hub, the zero-emissions kitchen is part of the most teched-out room of all, containing geeky extras like a dishwasher that senses how dirty the pots and pans are and a fireplace with an exhaust that sucks out smoke but not warmth. — **Sonia Zjawinski**

3 A range hood engineered by Ray Stewart, whose other models are found in McDonald's restaurants, traps all the steam, smoke, and grease that the Wolf gas burners and electric oven dish out.

4 The Asko D3531XL dishwasher uses sensors to detect how much grime is on whatever's inside, then adjusts water level and temperature accordingly. It also cools the contents after drying, to avoid steaming-hot cutlery.

5 Hydronic radiant technology circulates water through tubing embedded in a thin layer of concrete, which is sandwiched between wood panels and topped with bamboo flooring. In winter, a superefficient propane-fired boiler heats the water and the house. In summer, a 15,000-gallon underground geothermal reservoir cools the water and the house.



Architect: Michael McDonough


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BEDROOM & BATH LONDON

This ultramodern play-pad for homeowners Bruce Denny and Tim Cohen is fully wired, from the bed frames to the bathroom mirrors. All the electronics in the 2,600-square-foot flat are networked and accessible from video monitors and handheld remotes. You can even stay in sync with Big Ben – a rooftop cam can pipe footage of the clock to any display in the house. – S.C.

1

1 A 30-inch Samsung LCD emerges from the bed's footboard on a motorized lift and is connected to a dedicated 180-Gbyte Windows Media PC for accessing music and videos.

2 An 8.4-inch AMX Modero touch-screen can access the Web and be used to control lighting, entertainment, heating, and ventilation throughout the house.

2

3

4

5

3 The view into the bath can be blocked with an SSG Priva-Lite window: Press a button and electrical impulses "cloud" a liquid-crystal layer between two sheets of glass. Electrical wiring embedded in the mirror heats the glass just enough to eliminate fogging.

4 From the 58-gallon tub, bathers can use the remote-controlled rooftop cam to pan London's skyline and watch the real-time footage on a 30-inch LCD.

5 The wall-mounted toilet by Alessi has special hinges that keep the seat and lid from slamming down.

Architect: Thorp Design

Installer: Conference Communications

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1 Six 9-foot partitions made of insulated, laminated glass close off the theater from adjacent rooms. An inch-thick space between the glass panes serves as soundproofing.

2 An 8-foot screen shows off crisp visuals from a JVC projector hidden in a closet. The setup allows for a big screen with 1,400 x 788 native resolution that doesn't degrade the image. "Most home theaters are limited by the display system; this system is better than the source," says its designer, Mark Levinson.



THEATER NEW YORK

Fit for a superhero, Joe Quesada's Manhattan flat accommodates technology without sacrificing clean design. As editor in chief of Marvel Comics, Quesada can watch Spider-Man save the Big Apple from anywhere in his 4,800-square-foot loft. Six rooms, including the bath, feature flat-panel screens, but the real highlight is a theater that opens into a music room. —S.Z.



3 The massive media center relies on a 250-Gbyte Apple G5 and 400 gigs of external storage. The system holds up to 200 movies or 165,000 songs.

4 The Crestron control lets movie watchers dim lights, close blackout curtains, and lower the screen at the touch of a button.



5 Six LCDs throughout the flat—including a 15-inch in the bath—can display video streamed from the entertainment system.

Architect: Resolution:
4 Architecture
Installer: Mark Levinson of
Red Rose Music



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1 The bath showcases custom stonework from fabricator Baci, an Italian factory that has fully automated processes, even for the cutting and polishing of granite and limestone. More than 275 tons of rock was used throughout the house.

2 Low-emission glass (known as Low-E) is coated with microscopic metal-oxide particles that filter out UV rays, which can fade artwork and furniture, while blocking heat and allowing in light.

3 A 42-inch NEC plasma screen ascends from a bed's footboard. Any of the home's eight LCDs can access the media center, which pulls data from nine XM Radio feeds, iTunes, movies, and satellite TV. Each panel has its own TiVo and DVD player.

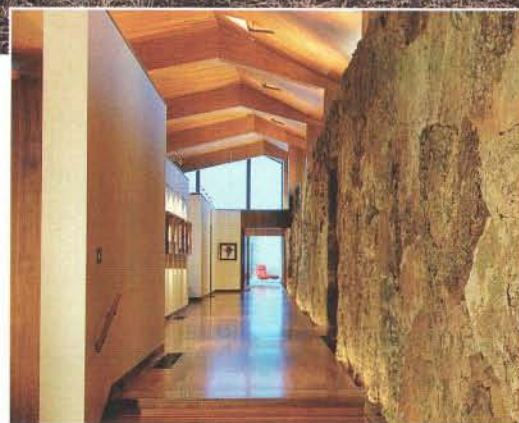


FULL HOUSE

ASPEN, COLORADO

This \$35 million mountaintop home is part of Wildcat Ranch, a 6,926-acre plot developed by actor Michael Douglas back in the '80s. The house has a 360-degree scenic view and looks down onto the Snowmass ski resort. The 14,400-square-foot residence is tech to the core: Its 6,000-square-foot basement is the command center, dedicated to geothermal and temperature control equipment, miles of wire, banks of monitors, and racks of servers. Visitors hardly notice this pad's horsepower. Home-automation design gurus ESC worked closely with architect Bartholomew Voorsanger to plan the software and integrate every household function into an ultrareliable computer network. Total cost of technology: about \$1 million. — **Todd Jatras**

7 A 200-foot-long stone wall covered with moss improves air quality and needs misting only once every six months.



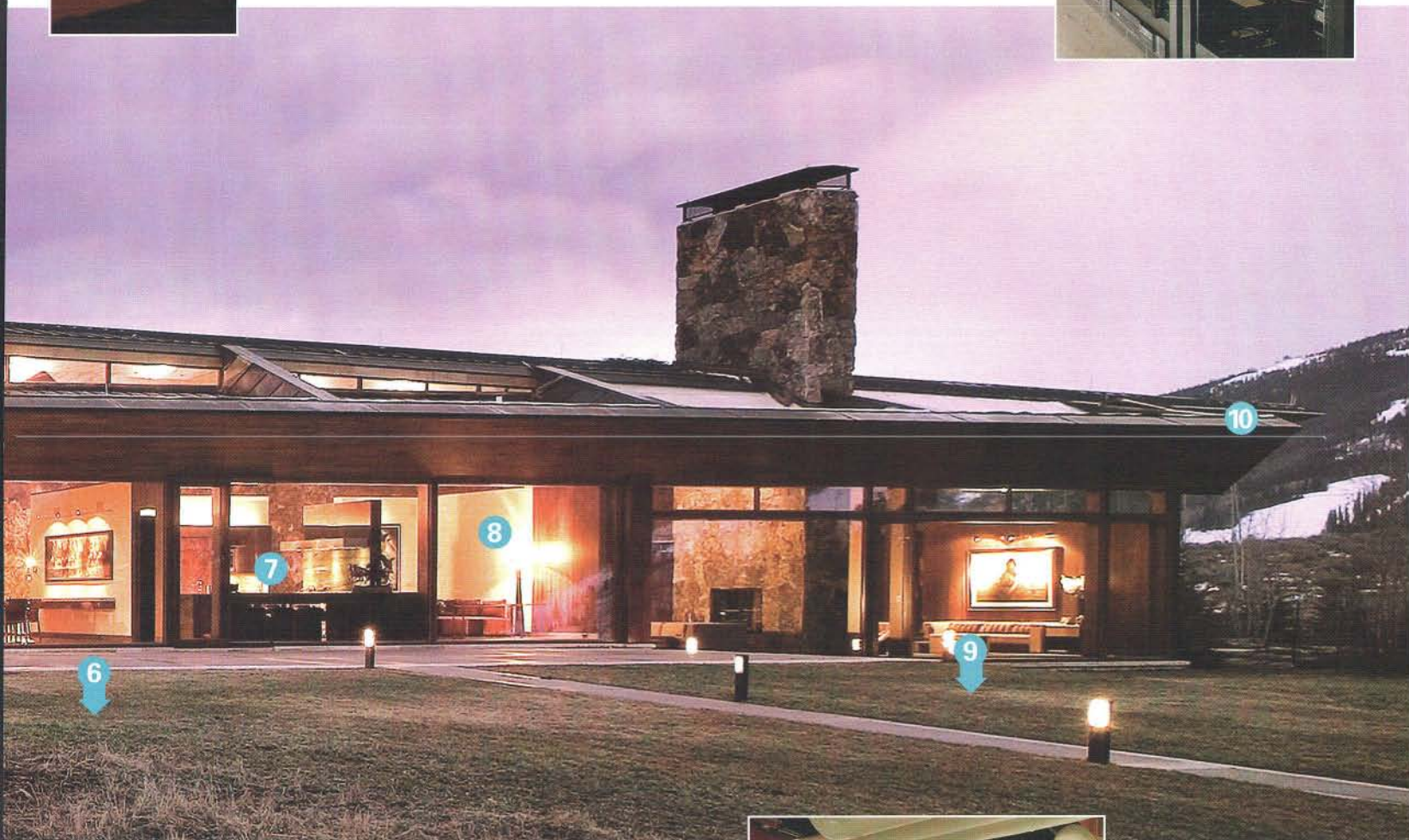


4 Ceiling pin lights, individually remote controlled, cast just enough focused light so one person can read while the other sleeps.

5 An NEC 42-inch plasma screen is stored vertically inside a cabinet and is pushed out and swiveled into viewing position by a robotic arm.



6 Server racks line the basement, which is about the size of a tennis court. The system automatically stays in sync with the changing seasons and raises and lowers window shades to adjust the amount of natural light and passive heat allowed into rooms.



8 AMX Wi-Fi tablets control every function of the house and grounds, from media to lighting and temperature.

9 Sixty geothermal wells take advantage of Aspen's year-round underground temp of 49 to 52 degrees Fahrenheit. In summer, the outdoor air can warm to 92 degrees; the temperature difference is used to cool a circulating water-based antifreeze and to power 70 tons of AC equipment via a heat exchanger. In winter, the system provides 95 percent of the home's utility power.



10 Hidden security cams dot the landscape. The owner, who was once the target of a remote-controlled pipe bombing, safeguards this home with a sophisticated security system.

Architect: Bartholomew Voorsanger
Installer: ESC

SUPER GEEK UPGRADES

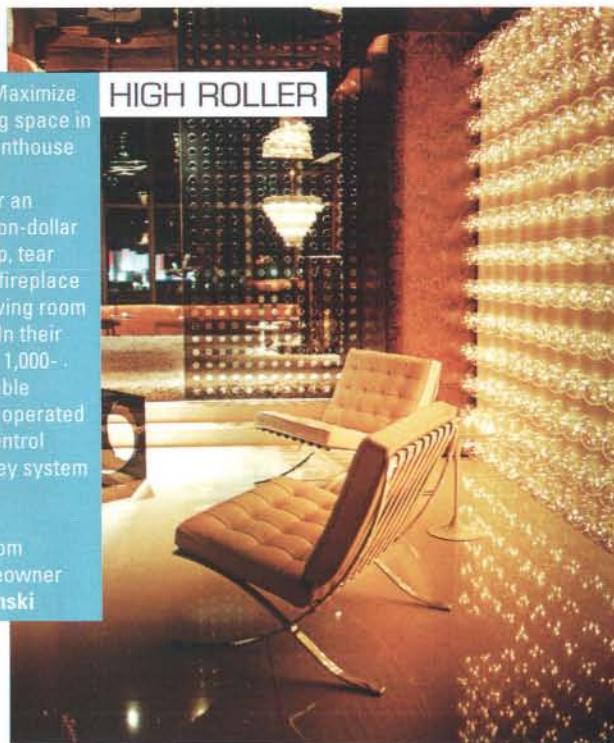
Four do-it-yourself projects
for the truly tech obsessed.

CHALLENGE: Maximize views and living space in a Las Vegas penthouse

SOLUTION: For an expansive million-dollar view of the strip, tear out a wall and fireplace between the living room and bedroom. In their place, install a 1,000-pound retractable partition that's operated by a remote control track-and-pulley system in the floor.

WHODUNIT: Tom Brietling, homeowner
— Sonia Zjawinski

HIGH ROLLER



FLIGHT DECK



CHALLENGE: Provide an optimal backyard perch for bird-watching along a prime migratory route in Dallas

SOLUTION: Install a 60-foot-long sky ramp that extends through the canopy of the forest on the property. A curved 1,000-square-foot glass wall reflects the woods. The effect is like watching Animal Planet in Imax.

WHODUNIT: Antoine Predock, architect
— Todd Jatras



SILENT MOVIE STUDIO

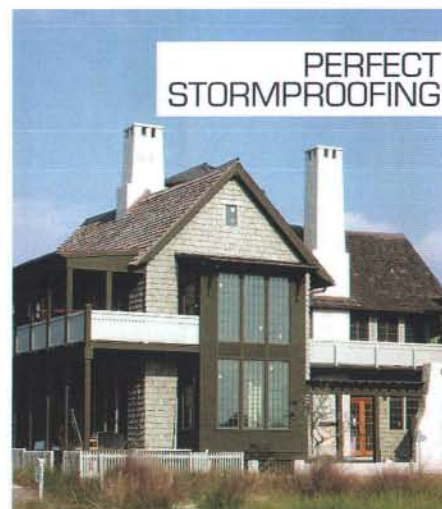
CHALLENGE: Mute the hum of equipment in a home recording studio

SOLUTION: Stuff all the hard drives, servers, and audio equipment into a climate-controlled closet off of a prefab sound studio. Then outfit it

with an industrial refrigerator door to eliminate sound leakage.

WHODUNIT: James Keach, homeowner and producer (*Walk the Line*); David Kulka, tech consultant; and Chris Sorensen, architect — S.Z.

PERFECT STORMPROOFING



CHALLENGE: Hurricane-proof a window-sheathed home on Florida's Gulf Coast

SOLUTION: Use bulletproof windows. The search for tough glass ended with a Canadian firm called Loewen. Each window is made of an inner core of elastic vinyl sandwiched between two panes of tempered glass. They can withstand two-by-fours shot out of a cannon or bullets fired from a Smith & Wesson .38 (one would-be burglar gave up after 23 rounds).

WHODUNIT: Brad Zeitlin, homeowner
— Andrew Tilin



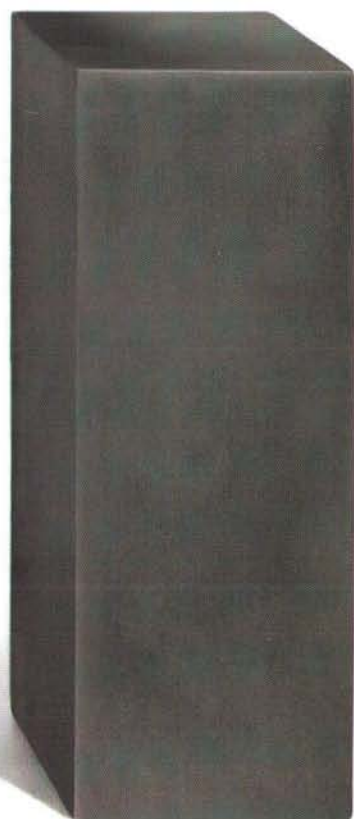
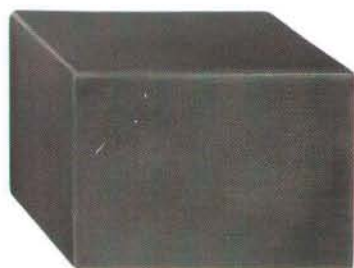
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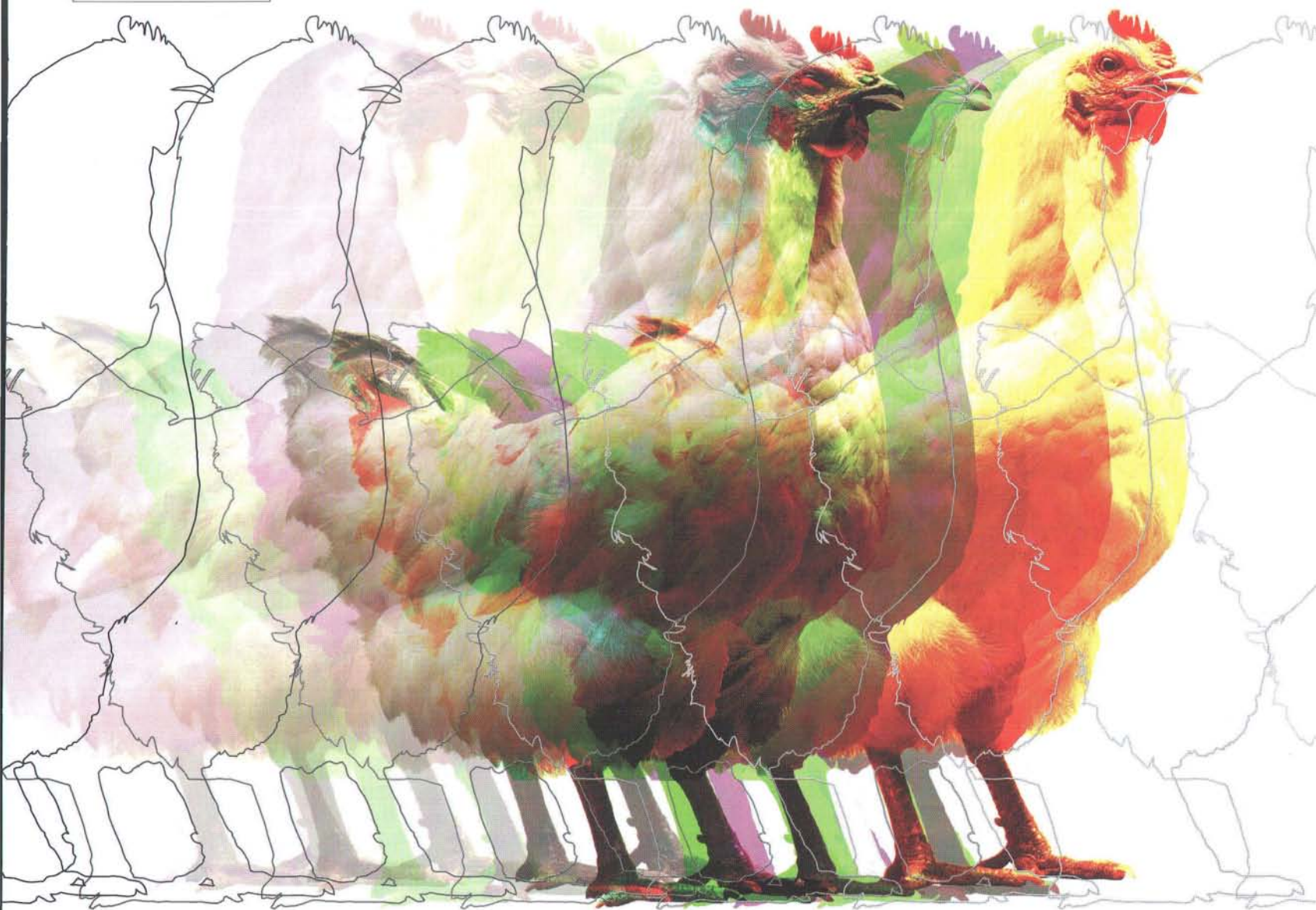
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THE BATTLE TO STOP BIRD FLU

The pandemic has hit New Mexico. Inside the Los Alamos weapons lab, massive computer simulations are unleashing disease and tracking its course, 6 billion people at a time.

by Thomas Goetz

On a cold January day in 1976, Private David Lewis came down with the flu. Struck with the classic symptoms – headache, sore throat, fever – Lewis was told to go to his barracks at Fort Dix, New Jersey, and get some rest. Instead, he went on a march with other grunts, collapsed, and, after being rushed to the base hospital, died on February 4. He was the first – and, as

it would turn out, the only – fatality of the great swine flu epidemic of 1976.

Lewis' death came just as health officials were starting to worry about an influenza outbreak in the US. The best science at the time held that flu epidemics erupted in once-a-decade cycles; since the last epidemic had occurred in 1968, the next one should be on the near horizon. As an article in *The New*

York Times put it just days before Lewis fell ill: "Somewhere, in skies or fields or kitchens, the molecules of the next pandemic wait."

At Fort Dix, a few other soldiers developed flu symptoms. When lab tests revealed that perhaps 500 on the base had caught the virus, officials at the Centers for Disease Control and Prevention faced a quandary. Was this the epidemic they'd feared, in which

case they should call for mass inoculation? Or should they play the odds, hoping the disease would go away as often happens?

They had little information to go on: the outbreak in New Jersey, isolated cases from Minnesota to Mississippi, and a flu virus that looked suspiciously like the strain that killed half a million Americans in 1918. Estimates for the chance of an epidemic ranged from 2 to 35 percent. Indeed, there was much the scientists didn't know about influenza, period. Flu viruses hadn't been isolated until the 1930s, and they are moody, fast-mutating pathogens. "The speed with which [mutation] can happen," the *Times* wrote, "is mystifying." When a strain was identified, there was no telling how virulent it was. At the time, the best computer models were in Russia, where health authorities were doing a fair job predicting the spread of flu from

population had received a shot. But by then, it had become clear that an epidemic was not, in fact, at hand. Lewis remained the only fatality – unless you count the 32 other people who died from the vaccine. Soon the program, the last major inoculation effort in the US, was canceled.

The 1976 swine flu scare has become enshrined as "the epidemic that never was," one of the great fiascos of our national health care system. But in truth, government officials performed well enough. In just a few months, they went from isolating a strange new flu virus to delivering a vaccine to every American who wanted one. The problem was, all they had were blunt instruments: crude mathematical models, rough estimates of infection rates, and a vaccine that often packed too strong a punch. They were fairly well equipped to react to a worst-case

through the US population – a plan that draws more from the Soviet approach to disease forecasting than from the CDC's approach in 1976.

Thirty years on, a new science of epidemiology is at hand. It's based on sophisticated computer models that can get ahead of a virus and, in a sometimes dazzling demonstration of computer science, provide exacting prescriptions for health care policy rather than best guesses. It's an approach pioneered not by physicians but by physicists. And it owes a lot to the nuclear bomb.

In 1992, the US announced a moratorium on nuclear testing. The move meant that the Pentagon could not use underground test explosions to "certify" its arsenal of weapons – to establish that its nuclear stockpile would work when called upon and be safe until that day. That forced the guardians of the stockpile – the nuclear scientists at Los Alamos National Laboratory in New Mexico – to devise new ways to do their jobs. And that meant massive supercomputer simulations.

Computer simulations have a long history at Los Alamos. They were first deployed at the lab during the Manhattan Project in the 1940s to model nuclear explosions – among the first computer models ever attempted. Early on, they were a coarse tool and no substitute for physical experiments; the physicist Richard Feynman, who worked at the lab in its earliest years, called them "a disease" that would lead scientists into computerized daydreams tangential to the task at hand. But over the next 50 years they became an important instrument at Los Alamos, indispensable to the study of nuclear fusion and rocket propulsion. The 1992 moratorium simply codified that role, making computer models the only game in town. Since then, the lab has built one of the world's largest supercomputing facilities, amassing a total of 85 teraflops of processing power.

One sim project has released anthrax in Houston, the plague in Chicago, and smallpox in Portland.

city to city. But those models took advantage of the Soviets' penchant for tracking the movements of their citizens; in the US, where travel was open, it was impossible to create such a forecast.

So on March 24, 1976, President Gerald Ford convened a "blue-ribbon panel" of experts from the CDC, the Food and Drug Administration, and the National Institutes of Health. After a few hours, Ford emerged with Jonas Salk, the doctor behind the polio vaccine, by his side and announced a plan "to inoculate every man, woman, and child in the United States." It was to be the largest immunization drive in US history.

The inoculations began on October 1. As of mid-December, 20 percent of the

scenario – they just weren't equipped to determine if one was imminent. Forced to guess, they chose "to risk money rather than lives," as Theodore Cooper, an assistant secretary of Health Education and Welfare, said at the time. "Better to be safe than sorry."

All of which raises a question: With the specter of an actual flu epidemic looming, are we any better equipped today? H5N1, the strain of avian influenza currently festering in Asia, has yet to pull off the mutation that would customize it for human-to-human transmission. But we know it's an especially lethal virus; most health experts expect it will make that jump soon enough. So the task for experts is to devise a plan that pinpoints how the virus might spread

How the Flu Will Spread

Los Alamos simulations predict that air travel will carry a disease like influenza from outbreak in Los Angeles to the rest of the country with remarkable speed and efficiency.



These tools are now being used in research that goes far beyond weapons work. Among the lab's 6,000 scientists, you'll find astrophysicists modeling white dwarf stars, chemical engineers replicating the effects of Florida hurricanes, geologists modeling the Earth's core, and biologists constructing microbial genomes. "All science is simulation these days," says Stephen Lee, the deputy division leader of computational sciences at Los Alamos.

The most promising application of sim science to real-world policy targets epidemic disease. A mile from the main compound at Los Alamos, in a grade school turned research lab, half a dozen physicists and computer scientists (and one mathematical biologist) are grinding out disease like pepper from a mill. This is EpiSims, an ambitious computer-simulation project that has released anthrax in Houston, sown the bubonic plague in Chicago, and, most recently, spread the flu in Los Angeles.

In 2000, EpiSims let loose smallpox in Portland, Oregon. Programmers started by creating a computer model of the city that's accurate down to the individual high school, traffic light, and citizen. In EpiSims, as in life, people go about their daily business. So on Tuesday morning, John Doe leaves his apartment in the Pearl District at 6:45, stops at Starbucks at 7:08, gets to his office parking lot at 7:45, greets his colleagues in the elevator at 7:49, and is at his desk checking email by 8:02. There are three-quarters of a million John Does in EpiSims' Portland, and just as many Jane Does, each with their own routines and encounters. This is the secret of EpiSims: its insatiable appetite for minutiae. EpiSims is the closest we've come to a huge city living inside a computer – or more specifically, several hundred computers. James Smith, who runs the EpiSims project at Los Alamos, describes his tools as "giant data fusion engines." Tapping the scientists' sophisti-



cated computing algorithms and the lab's supercomputer clusters, it takes

about 300 parallel processors and less than 24 hours to run a one-year simulation.

Smallpox is an opportunistic virus, eager to take advantage of incidental encounters. It spreads through the respiratory system and incubates for as long as 10 days before the onset of fluish symptoms – coughing, fever, stomachache. Only days later do victims develop a pustular rash – the pox. It is vicious; in an untreated smallpox epidemic, 30 percent of those infected will die.

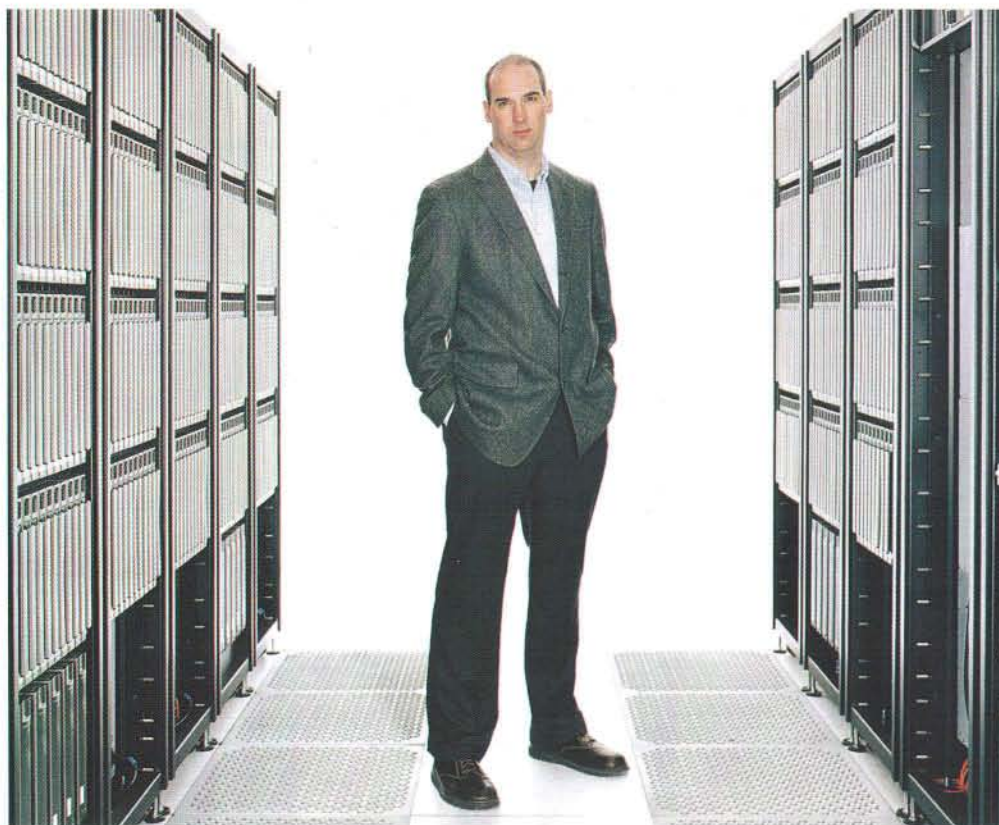
In the 2000 smallpox sim, the EpiSims team tracked the virus as it climbed toward its 30 percent fatality rate not all at once, but

James Smith's EpiSims software shows how disease spreads through a single city.

person by person: schoolteachers and shop clerks first, then office workers and hospital staff. As smallpox leapt from one unwitting victim to another, the EpiSims team watched disease ooze out of schools and shopping malls, erupt in downtown office buildings, and take root in neighborhoods. Within 90 days, Portland was teeming with smallpox. The epidemic was at hand.

But simulating the spread of disease is only half the job. EpiSims also had to evaluate how officials should respond. So, researchers rebooted the sim and Portland was once again alive and disease free. And this time the city had a plan of action. Four days after the first sign of virus, the authorities closed the schools, kicked off a mass vaccination program, and generally shut the city down.





And with it, the disease: In 100 days, it had run its course. That sim was followed by another with a slightly different response strategy, and then another. EpiSims eventually ran through hundreds of smallpox models, sometimes vaccinating only exposed individuals, other times targeting the so-called superspreaders, individuals who transmit more than their share of disease, sometimes putting the entire city in quarantine. With every tweak, the disease would peter out or gain steam accordingly.

The EpiSims smallpox models led to a handful of contrarian conclusions about epidemic disease. The first: "The super-spreader hypothesis isn't necessarily true," Smith says. This rule holds that in any population, the more social individuals – the hubs – are the principal conduits for spreading disease. Shatter the network by inoculating or removing these hubs, the theory goes, and you'll stand a better chance of knocking out the disease. But EpiSims has shown that we're all more popular than we might think. Even the most reclusive of us runs to Walgreens for toothpaste or drops by Boston Chicken for takeout. For a highly communicable disease like smallpox or influenza, these incidental interactions spread disease just as well as extended encounters. So chasing after the hubs

Backed by the world's most powerful super-computers, Tim Germann can stock his sim with 6 billion people.

simply to inoculate the entire city.

A second revelation: With a lethal pathogen like smallpox, response time is all. As the delay stretches from 4 to 7 to 10 days before officials move into action, EpiSims found that the outbreak becomes increasingly lethal. It turns out that, in the ticking moments after an epidemic strikes, *when* health officials act is more important than *what* they actually do. Start with inoculation. Or quarantine. Or school closings. It doesn't matter. What does matter is reducing the time between first outbreak and first response. At the same time, EpiSims warns against overreacting to a less-lethal disease – as in 1976, when standard health measures would have sufficed. (How to tell the difference? Run a simulation.)

These sorts of precise, real-world conclusions are the payoff of the EpiSims approach. They are, to use Smith's term, "actionable" – worthy of consideration not just by scientists but by policymakers. Such relevance has made EpiSims a darling at Los Alamos and an integral component of a Department of Homeland Security project called Nisac (for National Infrastructure Simulation and

can mean chasing after 80 percent of the population – a huge waste of time and energy. Better

Analysis Center), an effort to model a range of disasters and plot recovery strategies. Born in 2000 as a tiny \$500,000 joint project between Los Alamos and its sister lab in Sandia, New Mexico, Nisac got a \$20 million infusion after September 11, 2001, and a mandate to measure how the nation would fare after another deliberate attack, be it a dirty nuke or a bioweapon like smallpox.

More recently, as attention has turned to DHS's responsibility for acts of God as well as acts of terrorists, EpiSims has begun assessing the threat of avian influenza. With these new simulations, Smith's team is adding even more granularity. They're modeling the health care system down to the hospital bed, to see what happens if flu victims flood hospitals, fill the beds, and then spill back into their homes. They're taking into account slight behavior changes, so if people start wearing surgical masks, SARS-style, disease transmissions in the sim will fall off according to the masks' particulates-per-million filtration rate. The results go to the DHS and straight up the chain, helping inform the ultimate question that looms behind all of Nisac's work. "What do we tell the President?" says DV Rao, who directs the lab's Decision Applications division. At these highest levels, this sort of predictive science is an entirely new and unfamiliar decision-making tool. "I don't know what they make of it now," says Rao. "But in a year, hopefully they're going to say, 'All right. Tell us what we should be doing.'"

On a long flight to Maui in February 2003, Tim Germann, a physical chemist at Los Alamos, was reading Richard Preston's *Demon in the Freezer*. A vivid account of what's at stake if the last samples of smallpox escape US or Russian labs, Preston's warning struck Germann as real enough. But the scope of the danger was unquantified and apparently unquantifiable. Germann also had in his bag a copy of *Science* that included a piece coauthored by Emory University biostatistician Ira Longini. ("It was a long flight," Germann says.) Longini was investigating different vaccination strategies in the event of a smallpox outbreak. But his simulation sample totaled just 2,000 people – not large enough to extrapolate his conclusions to a larger population.

The reading made Germann wonder: Sure, a national outbreak of smallpox would be bad. But *how* bad, and how likely? And who would be at risk? Then Germann realized that he

had a way of finding out. His day job involved computational materials science, specifically, how metal atoms – copper and iron – would react under stress or shock. In an epidemic, Germann thought, people might behave like the atoms in his simulations. “Atoms have short-range interactions,” Germann explains. “Even though we’re doing millions or billions of them, every one just moves in its local neighborhood. People work in the same way.” So, just as a cooling metal slows down atoms, a quarantine slows down people. By bolstering these physics models with experimental data on things like how viruses circulate from children to adults, and he could conceivably model the entire US population, or even the entire global population.

Germann cranked up the simulation, adjusted the software, and added the parameters Longini had used to model his smallpox outbreak. That marked the birth of what would be called EpiCast – a combination of *epidemic* and *forecast*. “It’s basically still the same code,” Germann says. “We use it one day for running atoms and the next for people.” As it turned out, the model showed

6 billion people, it sounded very impressive. But I wondered if it was really possible.”

So Germann set to work creating flu scenarios to augment Longini’s NIH work. With nearly 300 million agents representing every man, woman, and child in the US, EpiCast doesn’t bother to track minute-by-minute behaviors as EpiSims does. Instead, Germann puts his computing power to work detailing how slightly different parameters – various antivirals or different isolation policies, for instance – have slightly different national repercussions. So far, the project has run about 200 simulations of an avian flu epidemic, models that have helped Longini’s group reach provocative conclusions that fall along two lines: how a nationwide outbreak might take hold, and what policies would best combat it.

EpiCast reveals that, in contrast with flu epidemics of decades past, an outbreak today won’t progress “like a wave across the country,” spreading from town to town and state to state. Instead, no matter where it erupts – Seattle, Chicago, Miami – it will swiftly blanket the nation. “It starts in Chicago one day,” Germann says, “and a couple

and Human Services released its pandemic influenza plan. The report offers a thorough and frank assessment of the havoc a full-fledged pandemic would wreak. The nation, the report says, “will be severely taxed, if not overwhelmed.” Disease will break out repeatedly, for as long as a year. Hospitals will run out of beds and vaccines. Doctors and nurses will be overworked to the point of exhaustion. Mass fatalities will overwhelm mortuaries and morgues with bodies. Before it has exhausted itself, the report estimates, the disease could spread to as many as 90 million Americans, hospitalizing 10 million and killing almost 2 million.

The report also sketches out how the federal government should respond in such a scenario. In effect, officials face what Bruce Gellin, director of HHS’s National Vaccine Program Office, describes as a reverse Hurricane Katrina: Rather than an all-out response focused on one particular region, a flu epidemic would force the government to ration its resources to serve the entire nation. How best to do that – tactically, quickly, and effectively – is now the focus of EpiCast’s work.

After the HHS plan was released, Germann and Longini were called to Washington for a strategy session with officials from the NIH, DHS, and the White House. Plenty of Los Alamos scientists, starting with Oppenheimer and Feynman, have made the trek to the corridors of the Capitol. But those trips were concerned with fighting wars, not disease. During the HHS meeting, the officials talked about how to apply EpiCast to the problem at hand. Germann explained the power of the tool. If HHS wants to know where to stockpile antivirals, EpiCast can pinpoint optimal locations. If the government wants to slow down the spread of disease, EpiCast can suggest whether to screen airline passengers by body temperature – and determine just how high a fever is too high to fly. If the first outbreak is in, say, Los Angeles, “do you send doctors from around the country to the West Coast,” Germann says, “or keep them where they are because it’ll be everywhere in a few weeks?”

Germann assured the group he could help. Then he returned to Los Alamos. Every question means a new sim, and every sim helps answer questions that are otherwise unanswerable. ■ ■ ■

Thomas Goetz (thomas@wiredmag.com) is Wired’s deputy editor.

Response time is key: What matters is when officials act, not what they do.

that smallpox may not be the cataclysm many imagine. Because of the long lagtime between successive generations of an outbreak (two weeks or more), and the tell-tale symptoms, smallpox would be quickly identified. That, plus the stockpiling, post-9/11, of large quantities of vaccine, means that “it should be possible to contain” an outbreak after the first few waves, Germann says.

The flu, by contrast, has a very short generation time (days instead of weeks) and generic symptoms. What’s more, it’s nearly impossible to stockpile a vaccine because the virus is so quick to mutate. Add the fact that people can be infected and contagious without knowing it, and you’ve got one vexing virus. So Germann called Longini and described how his molecular models could be adapted to epidemics. “I thought it was a bit preposterous,” recalls Longini, who has been modeling epidemics for 30 years, most recently with a National Institutes of Health research program investigating the risk of pandemic influenza. “When Tim told me he could model the whole country or the whole planet,

of weeks later it’s everywhere at once.” Thank the airlines. Even though disease has piggybacked on air travel for decades, we generally had only isolated outbreaks of low-transmission viruses – like when SARS leapt from Hong Kong to Canada in 2003 but failed to spread beyond Toronto. In an epidemic of a highly communicable disease, the airlines’ hub network would effectively seed every metropolitan area in the country within a month or two – and then reseed them, repeatedly.

EpiCast showed that local intervention measures can have some impact: Close the schools, enforce a quarantine, and the disease will slow down. That buys the federal government time to develop and mass-produce a vaccine. But Germann quickly adds a caveat: Acting locally may not be enough. In a worst-case outbreak, without a viable vaccine, “the disease will climb, and eventually go exponential. And once it’s on the exponential curve, it’s very difficult to contain.” Cue Richard Preston.

In November, the Department of Health

BLOG, BLOG, BLOG

REVENGE OF THE DOTCOM POSTER BOY

He was the king – and kingmaker – of New York's Silicon Alley, a new media cheerleader turned media mogul. Then the bubble burst. But, baby, he's back.

by Eryn Brown



Jason Calacanis, a few weeks after selling his blog company to AOL, at the Viceroy hotel in Santa Monica with his bulldog, Toro.

It's the Friday before Halloween, and Jason McCabe Calacanis, the onetime king of New York's Silicon Alley, is holding court in his new hometown of Santa Monica, California. Dressed in a chocolaty suede blazer, a BlackBerry glued to his hand, he walks into the poolside restaurant of the hipster-packed Viceroy hotel, asks for seats near a heat lamp ("for the lady") and balks when the hostess tries to seat us at a perfectly pleasant table for two. "We want the nice ones," he says, pointing to a larger setup with four fancy pillowed chairs. The hostess rolls her eyes, grimaces, and walks us over to the cushier table.

Calacanis doesn't notice, or doesn't care. He sits down, orders a bottle of Pellegrino, and begins talking and talking and talking, gushing for more than two hours. He talks about the trip he's planning for the next morning on a friend's private jet, to a Halloween party in New York. He talks about his fiancée, Jade, and the Japanese schoolgirl outfit she's going to wear ("She looks really hot in it!"). He talks about scaling up startups with an earnestness that would make a boom-era dotcommer blush.

He should know. He practically personified the dotcom rise and fall in New York City. The founder of Rising Tide Studios, Calacanis, now 35, built an empire – magazines like the *Silicon Alley Reporter*, parties, conferences, stylish offices – and then saw it suddenly all but disappear, to the delight of many of his peers. "People felt I didn't deserve it," he says between bites of autumn vegetable salad. "To be the Graydon Carter of that space was more power than anyone deserved."

It's easy to snigger at the swagger, but Calacanis has reason to preen. He hasn't merely survived the bust; he's thrived in it. The qualities that made him annoying to his New York colleagues during the boom – his abrasive demeanor, his hucksterism, his incessant networking – serve him well in the postbubble economy. While other Internet entrepreneurs lay low after the Nasdaq debacle, Calacanis forged ahead. He recognized early how huge blogging would become. He latched onto a great idea – an ad-based business that took advantage of the new Net infrastructure left behind by the boom. And, this time around, he had the smarts to sell while the selling was good. In October, AOL bought Calacanis' blog network, Weblogs,

Inc., for a figure reported to be around \$25 million.

The story of Calacanis' rise in New York's new media world goes like this: A bartender and a nurse in the outer reaches of Brooklyn have three sons. The middle one, Jason, puts himself through college at Fordham University, moves into a Manhattan apartment, and starts dabbling in computers and the early Internet. By 1996, he's figured out that he loves content – "software is so one-dimensional; it's not as much fun" – and begins publishing a 16-page social register-cum-technology newsletter called the *Silicon Alley Reporter*. He photocopies it himself and hand-delivers it to coffee shops and other digerati-haunted locales.

Thanks to good timing and aggressive promotion, the magazine catches on. It becomes a must-read for Manhattan's new media elite. CEOs and VCs vie for positions on its annual Silicon Alley 100 list. Calacanis throws huge, lavish parties. He publishes a sister magazine for the West Coast called *Digital Coast Reporter*. He charges people \$1,000 a head to attend his conferences. His

Calacanis' socializing prowess, were sitting at Madison Square Garden watching a ceremony for New York Knicks star Patrick Ewing and wondering what to do next. Blogging, which was just getting hot, seemed an enticing option. Two former *Silicon Alley Reporter* underlings, Rafat Ali and Xeni Jardin, were becoming well known at popular blogs paidContent and BoingBoing. "It was pretty clear they were having a better time and becoming a bigger brand when they weren't writing for me," explains Calacanis, who says he had read somewhere that Ali was making \$60,000 to \$70,000 a year from advertising.

Calacanis and Alvey wanted to get in on the action, but the scale and limitations of blogs bugged them. "We decided that one blog, like Rafat's, could make tens of thousands of dollars a year," says Alvey. "Definitely enough for one person who works 24 hours a day to sustain a business. But how could you get so that you could add more people?"

The answer, they decided, was to build a network of blogs. They ran some quick calculations. A franchise scenario with only

The new reason to preen: He just sold to AOL for \$25 million.

staff grows to about 70. Calacanis becomes the insiderest of insiders, partying with – and selling ads to – the tech icons he's writing about.

Then the whole thing unravels. By 2001, the Nasdaq has plummeted and it's nearly impossible to find new Net deals to cover, much less companies to advertise in a glossy magazine that specializes in throwing massive sushi parties. Calacanis lays off half of his staff, shutsters the offices, and quietly transforms the *Silicon Alley Reporter* into the *Venture Reporter*, a journal of venture capital deals. He eventually sells the business for a sum that "had one comma," as he puts it, to a publishing company called Wicks Business Information, which in turn sells it to Dow Jones & Company.

Weblogs was born while the Wicks deal was coming to a close. It was February 28, 2003, and Calacanis and his business partner, Brian Alvey, a childhood friend from Brooklyn whose programming skills match

a few blogs wouldn't give them economies of scale, they figured. But at 100, 200, or 500 blogs, the numbers looked more appealing. A network could hire just a handful of people to manage tech support and ad sales for dozens and dozens of bloggers. "We'd partner with them and say, look, all you have to do is blog," Alvey says. "Don't worry about the software, don't worry about newsletters, upgrades, finding a sales team, and all this other stuff. Don't worry about anything. Just do what you do. Write about the thing you love to write about."

With such support, the thinking went, happy bloggers would become more entertaining and productive, generating millions of pageviews and millions of ad dollars. Marketers who might be nervous about advertising on a blog written by some impassioned nobody would get peace of mind knowing there was a corporate structure running the books and at least loosely monitoring the site's content. Better still, rather than having to contract

with 100 different blogs, advertisers could talk to a single ad sales rep.

The friends partnered 50-50, using money from the Wicks deal to get Weblogs started. They set up shop in two home offices – Calacanis' in Santa Monica and Alvey's in White Plains, New York – and began wooing bloggers who could cover tech, media, consumer issues, and more. They worked from a list of 400 to 500 potential blog subjects, culled from studying the titles on magazine stands.

Calacanis and Alvey were not the first entrepreneurs to create such a network – Nick Denton had launched Gawker Media in 2002. But Weblogs took a different approach. Denton kept Gawker relatively small and focused, but Calacanis and Alvey went unabashedly for scale. "We set the goal to build a huge business," Calacanis says. But the two had learned their lessons from the bubble, and huge meant something different this time around. Weblogs keeps overhead low, hiring just a handful of full-time staff and trading fancy headquarters for a confederation of home offices connected by cheap communications services like Gmail,

Weblogs may not have swank offices with foosball tables and massage chairs, but the business is built on the burgeoning online advertising market, a part of the Internet economy that was grossly underestimated in the years after the bust. Back in the late 1990s, companies didn't really understand how to advertise effectively on the Web. Today, with sophisticated tracking tools that help them measure return on their ad dollars, savvy advertisers are willing to pay big for Net real estate. According to a recent report by the Interactive Advertising Bureau and PricewaterhouseCoopers, US online advertising revenue in the first six months of 2005 was \$5.8 billion, up 26 percent from the same period the year before. Forrester Research projects that spending for online advertising and marketing will hit \$26 billion by 2010. At the time of the AOL sale, about 10 blogs in Calacanis' network had already sold all their ad space through the rest of the year, and the company was pulling in a bit more than \$1 million a year in ad revenue. Calacanis has signed on with AOL as CEO of Weblogs and, with the help of the parent company's name and the 100 million monthly

gers who could jump ship at any moment. Acquisition valuations for traditional media companies are usually equal to revenue, while a really hot property might get one and a half or twice that, according to Forrester Research analyst Charlene Li. Calacanis got vastly more than that, making it hard not to think "bubble." Even he tempers his assurances – just a tad. "I can feel a little bit of froth today," he says. "Not a bubble, but froth."

Not that Calacanis is going to spend a lot of time worrying about it. For now, he's happy to drive waiters nuts with picky double macchiato orders and to rhapsodize nonsensically about how he'll use "citizens' media," as he calls blogging, to turn the publishing world on its head. Calacanis says he wants to "poach *The New York Times*' best writers" and insists that his writers, many of whom do not earn a living wage as bloggers, think he's a sucker. "They say, 'You're going to pay me to write about Macs? I love Macs. You're going to make my hobby 30 percent of my income!'" Calacanis is annoyed by writers he considers old-guard. He mimics them complaining: "'Where are my benefits? Who's editing me?'"

It may be that the real reason AOL hired Calacanis was to tap into his experience and his abrasive-but-effective way of getting things done. "There's no limit to how far I could go in AOL – it's just the limits they put on me. I'm not in line to be CEO of AOL, but it's obvious that's where I'll end up, if I stay focused. Somebody's got to be the next CEO of AOL. Why not you?" he says, shifting into some kind of conversation with himself.

He tells me about a video circulating on the Web of a recent speech in which AOL CEO Jonathan Miller said that bringing Calacanis on board was part of the "succession plan." Calacanis pooh-poohs the comments but then, a few days later, manages to bring them up again. Sitting in his sparse home office, leaning forward in his desk chair and reading emails as he talks, he offers to forward a link to the clip.

Only then, as offhandedly as seems humanly possible, does he include the obligatory disclaimer. "Of course, everyone knows it was a joke," he says, eyes glued to his monitor. ■ ■ ■

Eryn Brown (eryn_brown@sbcglobal.net) wrote about domestic defense technology in issue 12.07.

"Somebody's got to be the next CEO of AOL. Why not you?"

eFax, and AOL Instant Messenger. Calacanis' bloggers are freelancers; they buy their own computer equipment and pay for their own Internet connections. Most of them don't earn much for their work – somewhere between a hundred and a couple thousand dollars a month. Calacanis and Alvey also didn't get too wrapped up in venture funding, ultimately taking only a "modest" angel investment, from Broadcast.com cofounder Mark Cuban.

The strategy worked. Within a year of starting, they had about 50 freelance bloggers and solid monthly advertising revenue. They were profitable. A few of the blogs, including games-oriented Joystiq, car-focused Autoblog, and gadget-obsessed Engadget (written in part by Peter Rojas, whom Calacanis lured away from Gawker by promising equity), became immensely popular. Calacanis says he knew the company had hit the big time when Engadget snagged an interview with Bill Gates in May 2005.

visitors who come to its sites, he expects to soon double or triple Weblogs' revenue.

For AOL the deal is about more than just a few million in ad money. It's about changing the way it does business. Weblogs came along just as AOL was focusing on becoming more of a portal and looking to shed its old subscription-based business model. "We had these really big Web sites," says Jim Bankoff, AOL's programming chief, "but what we didn't have was a way of entering, in a quick and rapid and scalable way, into smaller categories of topical passion."

Will it pay off? The inner financial workings of blog networks like Weblogs are shrouded in secrecy, and measuring blog traffic can be elusive because bad guys often try to game the system by bumping up pageviews and incoming link counts. So while Calacanis and a few other blog types insist that AOL's rumored buying price is completely reasonable, it's not clear that \$25 million is a sane amount for 10 disconnected employees and a network of blog-

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ALL HANDS ON DECK

In September, Rolex Watch U.S.A. treated participants in the Rolex International Keelboat Championship to a gorgeous night under the stars at the exclusive Rolex Crew Party. Co-hosted for the third year by Rolex, WIRED Magazine, Condé Nast Media Group, and select other Condé Nast magazines, guests enjoyed food, drinks, and live music in picturesque Annapolis, Maryland at the Chesapeake Bay Foundation in picturesque Annapolis, Maryland. Title sponsor of the regatta since its inception in 1985, Rolex continues to be a committed supporter of women's athletics.



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50 Robonaut

Not all NASA robots drive around poking at rocks. This android will one day work alongside people on space stations. Robonaut is the same size and shape as a person in a space suit, so it can handle tasks typically performed by humans – its hands are even better articulated than an astronaut's gloved digits. The fact that it looks like Boba Fett? Lucky coincidence.



THE 50 BEST ROBOTS EVER

They're exploring the deep sea and distant planets. They're saving lives in the operating room and on the battlefield. They're transforming factory floors and filmmaking. **They're – oh c'mon, they're just plain cool!** From Qrio to the Terminator, here are our absolute favorites (at least for now).

by Robert Capps

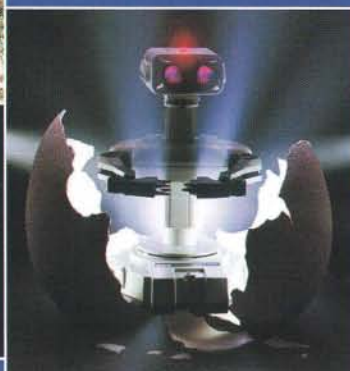
49 Leonardo

Awww, isn't it cuddly? Or maybe just creepy. MIT's Cynthia Breazeal is famous for building robots that humans have an emotional reaction to. Her newest creation, Leonardo, was bolted together in 2002 with the help of the movie monster gurus at Stan Winston Studio (their animatronics include the Terminator, the aliens in *Aliens*, and the dinosaurs in *Jurassic Park*). Leonardo can grab objects, make facial expressions and complex gestures, and even learn simple tasks (like turning lights on and off) through trial and error.



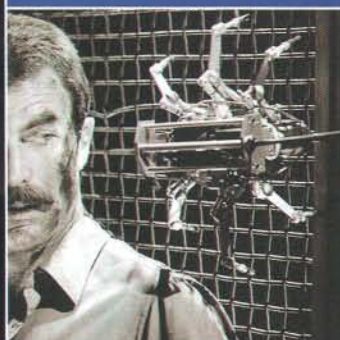
48 KITT

The smooth-talking, self-driving muscle car from the early '80s TV drama *Knight Rider* was so cool, it even upstaged David Hasselhoff. The success of this Trans-Am helped to usher in a new genre of show with super-vehicles as heroes, from *Airwolf* to *Stealth*.



45 Nintendo R.O.B.

In the mid-'80s, the PC was killing the market for videogame consoles. The game industry's only hope? A robot. Nintendo packaged the Robotic Operating Buddy with the 1985 Nintendo Entertainment System. The R.O.B. didn't do much, but the gimmick helped Nintendo sneak systems onto shelves. Lo, the console market was saved.



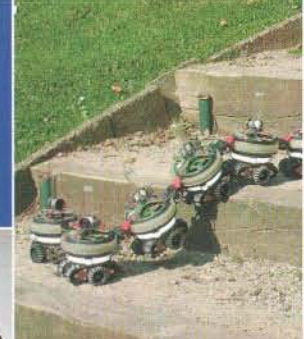
43 Attack Bots From Runaway

Tom Selleck got top billing, but the real stars of Michael Crichton's overlooked 1984 thriller were the spider attack drones. OK, their weapons were low tech (they sprayed acid at people), but the bug bots presaged Genghis (see #14) and similar critters in *The Matrix* and Steven Spielberg's *Minority Report*.



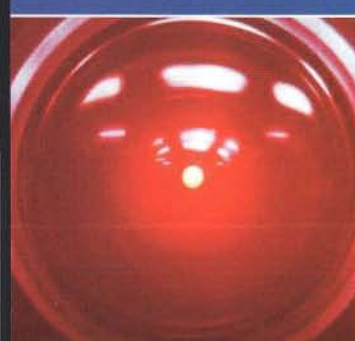
41 Mobots

What would you get if Robby the Robot got busy with a Mars rover? Probably something like the Mobots. In 1960 Hughes Aircraft unleashed these industrial machines for use in hazardous material sites – teleoperators controlled the snaking appendages. Alas, like the Spruce Goose, they weren't financially viable.



39 s-Bots

An ongoing project of the EU's Future and Emerging Technologies program, these minibuggies show strength in numbers. Each s-Bot is fully independent, but get a bunch in a room together and they'll form a chain to carry heavy payloads or bridge obstacles. Kinda like ants on roller skates ... in a conga line.



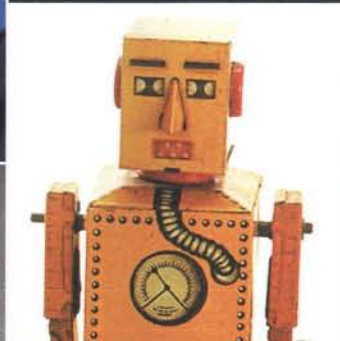
47 Hal 9000

Some tasks are too important to be left to humans. Just ask Hal 9000 from 2001: *A Space Odyssey*. The 1968 film gave the world the ultimate all seeing, all knowing – and apparently all ego – AI villain. It set the standard for machines that can think (and kill) like us but are too powerful to control.



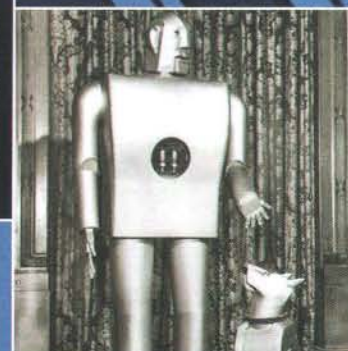
44 SlugBot

Meet a real-life hunter bot. Built in 2001 at the University of West England, SlugBot uses a vision sensor and an extending arm to find slugs, grab them, and drop them into an onboard trap. The idea is that one day it will deposit the slugs in its dock and use the gas from the decomposing bodies to charge its fuel cells.



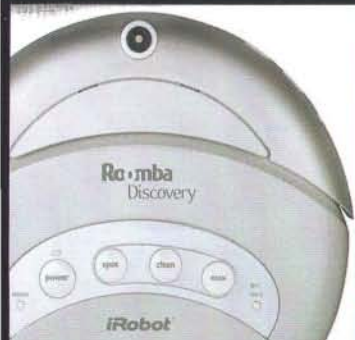
42 Lilliput Toy Robot

Before there were real robots, there were toy robots. Among the first was Lilliput, a windup walker from the 1930s. It couldn't do much – the legs would walk, causing the arms to swing. But by the late '40s, the tin tykes had spread from Japan to the US, earning a spot in toy history alongside teddy bears and fire trucks.



40 Elektro and Sparko

Westinghouse engineer Joseph Barnett made a splash at the 1939 World's Fair with a 7-foot, cable-controlled metal man that could walk, speak 77 words, and even smoke cigarettes (so debonair). The next year Barnett gave the hulking android a best friend: a robotic dog that seemed to bark and sit in response to Elektro's commands.



46 Roomba Discovery

This wasn't the first robosucker, just the first that didn't blow. In 2005, iRobot's second-generation robotic vacuum showed that domestic bots can actually work. To clean the floors, simply turn the thing on – just try not to stand around watching slack-jawed.





38 Sony AIBO

Think this is a hunk of plastic that won't fetch a tennis ball? Think again. It's actually an advanced piece of robotics that won't fetch a tennis ball. Introduced in 1999, AIBO is one of the most sophisticated toys on the market. It can find its docking station, recognize its owner's face, and respond to voice commands.



35 The Iron Giant

This 100-foot-tall combat machine from the 1999 movie wields an energy cannon and snacks on cars. But he really gets in gear playing hide-and-seek with a schoolboy. The giant eventually achieves robot enlightenment, realizing that he controls his own destiny (even if that means head-butting a suborbital nuclear weapon). It's a classic example of how robots — like all technologies — are neither good nor evil, just tools of circumstance.



37 RB5X

It hit store shelves in 1985, and this first-ever mass-produced home robot kit is still sold today. RB5X can be programmed to speak, navigate a room, and perform such simple tasks as retrieving small objects. Of course, its real claim to fame was as a sweet prize on the '80s videogame quiz show *Starcade*.

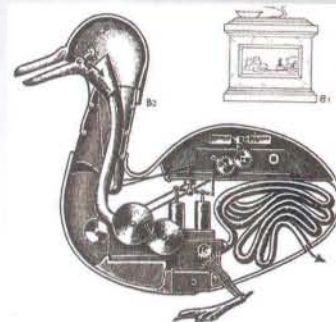


36 Packbots

From the creators of the Roomba comes a kick-ass droid for the US military. Carried on a soldier's back, it can be tossed into a building or under a car, where it will assess the situation (or maybe just be blown up). First deployed in Afghanistan in 2002, it's now on active cannon-fodder duty in Iraq.

34 Optimus Prime

Robots are cool. Robots that turn into giant trucks – way cool. Robots that turn into giant trucks and command a fleet of autobots – now that could change pop culture history. Such was the impact of the Transformer when the toy line was introduced in 1984, spawning decades of TV shows, movies, and comic books.



29 Vaucanson's Duck

Back in 1739, Jacques de Vaucanson wanted to create artificial life. He settled for a mechanical duck that pooped. The machine used a weight system to quack, flap its wings, drink water, and eat grain, which it would digest mechanically and expel through an opening in its backside.



33 The Turk

Step right up and marvel at the mechanical device that can beat you in chess. Not impressed? You would be if it were 1769. The contraption was a hoax (inventor Wolfgang von Kempelen stashed a human chess master inside), but it sparked early debates over what it means for a machine to think.



32 ABE

Mars may belong to the rovers, but the oceans belong to the Autonomous Benthic Explorer. Completed in 1995 by the Woods Hole Oceanographic Institution, the first fully independent underwater scout can dive down to 15,000 feet, map thermo layers and collect water samples, then swim home on its own.



31 GM Unimate

After bonding over their mutual love of sci-fi, engineers George Devol and Joseph Engelberger invented the industrial robot. They must have been reading very utilitarian fiction – their 1961 creation was a 4,000-pound arm that stacked sheets of hot metal. But it transformed the assembly line; a variant is still in use today.



30 The Tin Woodman

While technically a cyborg, the heartless lumberjack of Oz did wrestle with a common existential dilemma faced by robots: the desire to feel. (Well, that and the desire to combat rust.) Not bad for 1939. And hey, how many other robots sing and dance with Judy Garland?



28 The Terminator

Apparently robots of the future like to hit the gym. Out of a long line of assassin bots, the Terminator is the perfect blend of indestructibility and determination. With him, James Cameron personified what we really fear about robots: They'd do better without us.

25 Partner Ballroom Dancing Robots

Some robots build cars, some explore space, some do the cha-cha-cha. In 2005, Tohoku University's Kazuhiro Kosuge debuted a series of ballroom dancing androids, complete with fancy dresses. They can predict the movements of a partner, enabling them to follow another dancer's lead. And they're klutz-proof: There are no toes to step on.



27 MQ-1 Predator

Forget fantasy robots that kill people — here's a real robot that kills people. The US military's famed unmanned aerial vehicle became a household name in 2002 after taking flight in Afghanistan. Now armed with hellfire missiles, it no longer just monitors enemies — it blows them up, too.



26 False Maria

The classic sexbot from Fritz Lang's 1927 *Metropolis* was one of the first mechanized humans on film. She danced topless, incited riots, and sparked duels, but what really got her off was overthrowing the ruling class. No wonder she inspired every vision of an android for the next 80 years.



24 Elsie and Elmer

Neuroscientist W. Grey Walter's mechanical tortoises from the 1940s were the first fully autonomous electric robots. Programmed to seek out light and to turn if they ran into an object, they could find their illuminated charging stations, even if something was in the way.



23 Gort

In the 1951 flick *The Day the Earth Stood Still*, spaceman Klaatu and his robot Gort come to Earth to promote peace. When that doesn't work out, Gort teaches us what happens to those who eschew harmony — they die. Oh the irony that a machine must remind us of our humanity.



22 Rossum's Universal Robots

Czech author Karel Capek coined the term *robot* in his 1920 play about automaton factory workers. One problem: The characters that gave a title to all robotics weren't actually, you know, robots. They were biological creatures — more Jango Fett clones than C-3PO.

21 Personal Satellite Assistant

Legs, wheels, and treads – those are for bots that can't get off the ground. NASA's Personal Satellite Assistant possesses none of these things; instead it uses small fans to propel itself through zero gravity. Perhaps as soon as 2007, these assistants will hover over an astronaut's shoulder, serving as an all-in-one PDA, videophone, and air monitor.




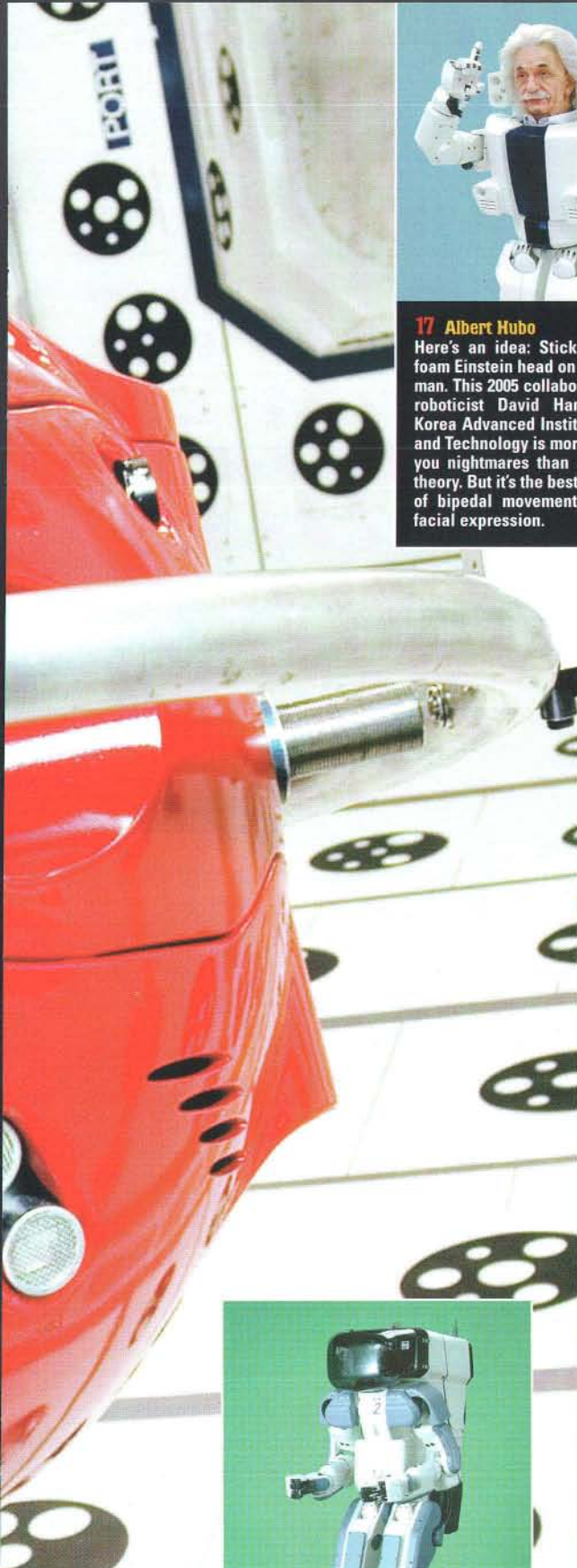
20 Mindstorms

Since 1998, Mindstorms have been turning 8-year-olds into fledgling roboticists. The Lego kits come with programmable blocks that animate all manner of dinosaurs, vending machines, unmanned planes – whatever kids, or more likely their parents, can dream up.



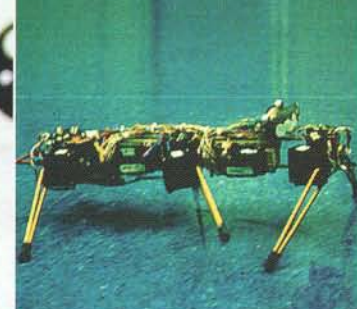
19 R2-D2

R2-D2 and C-3PO – the Abbott and Costello of space – may be the most popular robots in history, but it's the littler one that really steals the show. Sure, C-3PO could walk and speak 6 million languages, but R2-D2 proved that robots can be emotive without being humanoid and don't need to speak English to communicate.



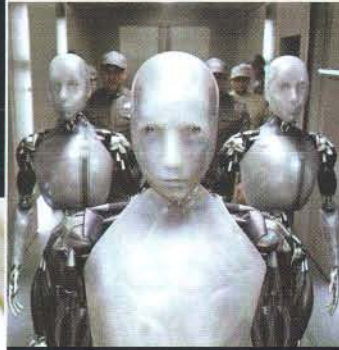
17 Albert Hubo

Here's an idea: Stick an elastomer foam Einstein head on a robot space-man. This 2005 collaboration between roboticist David Hanson and the Korea Advanced Institute of Science and Technology is more likely to give you nightmares than a unified field theory. But it's the best combo to date of bipedal movement and realistic facial expression.



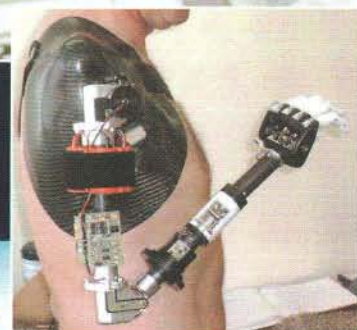
14 Genghis

Creeped out by bug bots? How about bug bots that can learn? In 1988, Rodney Brooks' lab at MIT created this six-legged walker, which taught itself how to scramble over boards and other obstacles. The secret: Allow each leg to react to the environment independently and you won't need to program every complex step.



11 Speedy

Before Sonny (shown) made Asimov's three laws of robotics known to the masses, there was Speedy, the robot in the 1942 short story *Runaround* that inaugurated the directives. Speedy knows not to harm humans, to obey their commands, and to protect itself, just not which rules matter most. Turns out a bot's needs come last.



13 Edinburgh Modular Arm System

Part man, part machine, all Scottish: Campbell Aird received the first complete bionic arm in 1998. Pressure sensors in the shoulder attachment detect minute fluctuations in Aird's muscles, activating motors that control the arm's movement. Eat your heart out, Lee Majors.



16 Robart III

Not only does Robart III have a gun, it has a team of spider "slave" bots. Under development by the Navy since 1992, this security robot uses microwave motion detectors to search, say, a hostile building for enemies, sending out its insectoid companions to look in dark corners. Alas, its barrels hold only rubber bullets and darts.



10 The Stanford Cart

Grand Challenge finishers, UAVs, and even KITT from *Knight Rider* all owe a debt of gratitude to James Adams and Hans Moravec's Stanford Cart. In 1979, the wagon traversed a chair-filled room on its own, a landmark achievement for self-navigating vehicles. Travel time: roughly five hours.




12 T-52 Enryu

What's better than an 11-foot-tall robot? An 11-foot-tall robot that can rip cars in half and lift 1,100-pound slabs of concrete. Japanese manufacturer Tmsuk unleashed Enryu in 2004 to help in rescue operations (think earthquakes). The best part: It's piloted from a cockpit in its belly, manga style.



15 Wabot And Wabot 2

In the '70s, some roboticists were building machines to make Chevettes, but researchers at Tokyo's Waseda University were building bots in man's image. In 1973, they introduced Wabot, the first full-scale programmable android. It had eyes, flailing limbs, and the ability to speak Japanese. The next rev, Wabot 2, played piano.



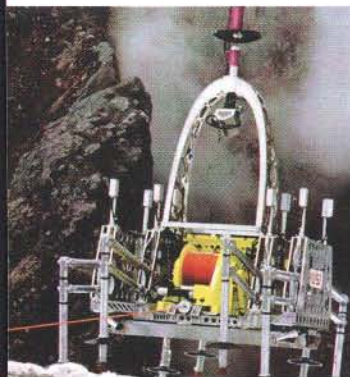
18 Honda's P2

Asimo? A pipsqueak. Before Honda's much-hyped biped was touring the world, there was P2, a 6-foot, 462-pound prototype. Unveiled in 1996, P2 possessed most of Asimo's walking skills – including the ability to climb stairs – making it, as Honda puts it "the first self-regulating, two-legged humanoid walking robot."



07 The Mechanical Knight

Way back in 1495, Leonardo da Vinci designed what was probably the first robot – an automated suit of armor with a windup crank. It could sit up, wave its hands, and maybe even talk. Five hundred years later, engineer Mark Rosheim used the master's schematics to build a working miniaturized version (shown here).



09 Dante II

After eight volcano researchers were killed in two 1993 eruptions, robots were brought in to take the heat. The next year, Carnegie Mellon's Dante II was lowered into Alaska's steaming Mount Spurr to collect data. It fell in, but not before uploading its readings, making it the first "successful" terrestrial explorer robot.



08 Da Vinci Surgical System

In the future, you'll beg to be operated on by a machine. Credit Intuitive Surgical's 2000 robot, a fusion of arms, cameras, and instruments that allows doctors to slice into patients remotely. Procedures done with the da Vinci are more precise than when humans wield the scalpel – research shows there's less blood loss and quicker recovery.

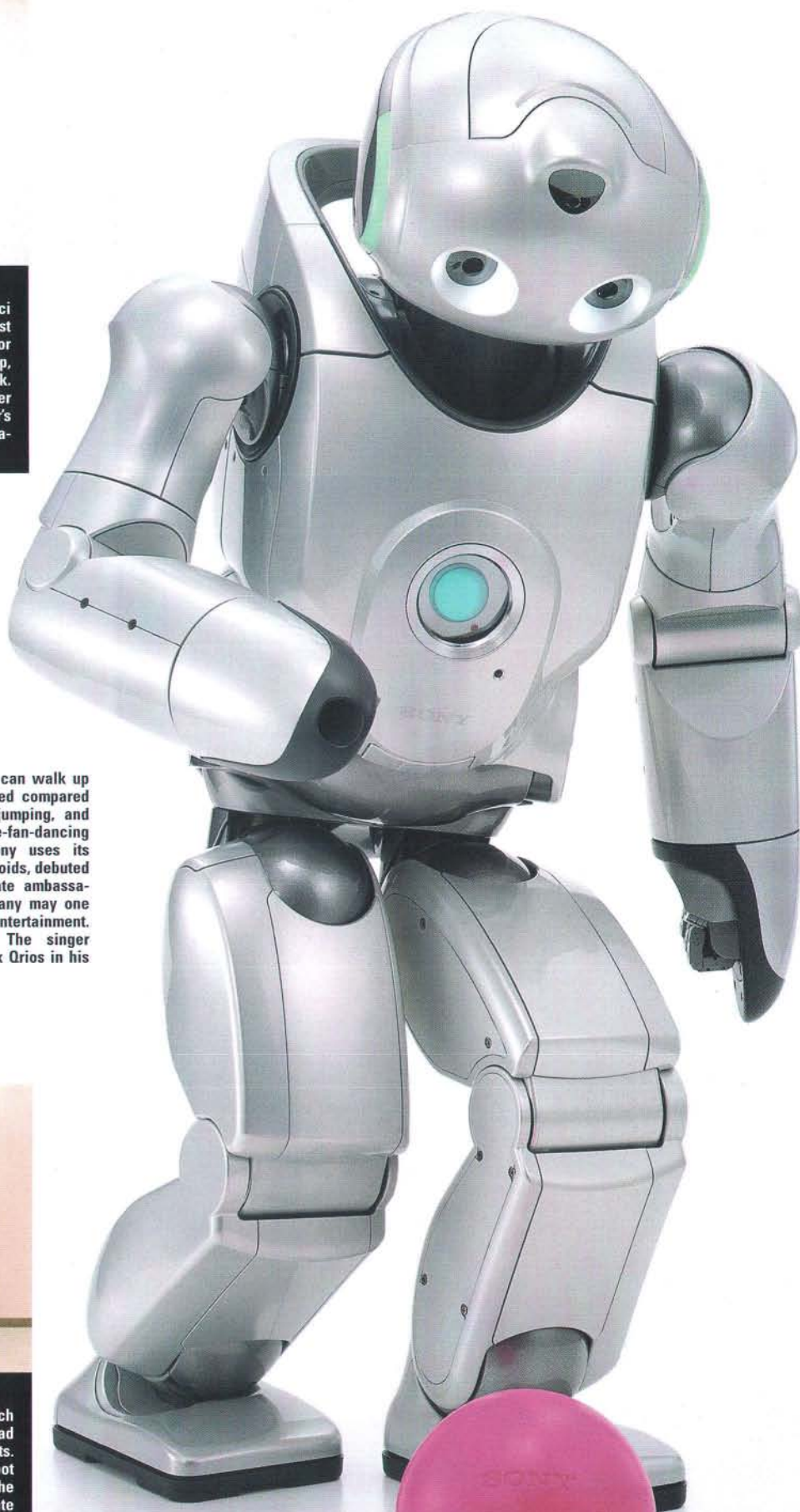


05 Shakey

Developed by Stanford Research Institute International, Shakey had jerky, often nonsensical movements. But that didn't stop the 1972 robot from entering the history books as the first machine to autonomously locate objects, steer around them – and then explain its logic for doing so.

06 Qrio

Bipedal robots that can walk up stairs seem flatfooted compared with the running, jumping, and traditional-Japanese-fan-dancing Qrio. Officially, Sony uses its state-of-the-art androids, debuted in 2003, as corporate ambassadors. But the company may one day sell them for entertainment. Works for Beck: The singer recently used all six Qrios in his video for "Hell Yes."



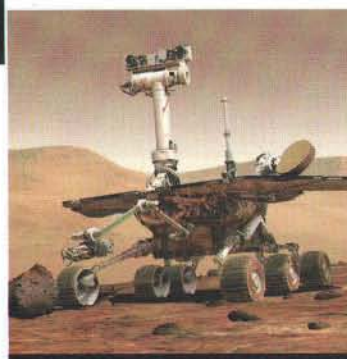
And the #1 Robot of All Time Is

02 Astroboy
While American kids were day-dreaming of Superman, Japanese tykes were worshipping at the altar of Tetsuwan Atom, aka Astroboy. First drawn in 1951, Astroboy has rocket boots, lasers that shoot from his fingertips, and, uh, an ass cannon. The lovable crime-fighting robot was an inspiration to a generation of kids — some of whom went on to become robotics researchers. He's a big reason why Japan is at the forefront of android development today. Domo arigato, Mr. Roboto.



04 Robby the Robot

Few robots can trace their origins to Shakespeare. Robby, from the 1956 film *Forbidden Planet*, was inspired by Ariel in *The Tempest*. But that didn't keep Robby from leaving a legacy all his own. For decades, the very idea of a robot was synonymous with Robby's bulbous figure.



03 Spirit and Opportunity

Some robots sit in labs for researchers to tinker with. These two bots are on frickin' Mars. Expected to last only three months when they touched down on the Red Planet in January 2004, the rovers are still going strong two years later — each sends back 100 megabits of data a day.

50: DAN FORBES, STYLED BY SHANNON AMOS/ARTIST UNTIED; 49: PHOTO RESEARCHERS; 48, 47, 43, 30, 28, 26, 23, 4: KOBAL; 46, 36: IROBOT; 44, 24: IAS LAB; 42: NOEL BARRETT ANTIQUES & AUCTIONS LTD.; 40, 41, 22: CORBIS; 39: DR. MARCO DORIGO, SWARM-BOTS PROJECT COORDINATOR, FUNDED BY EUROPEAN COMMISSION, FUTURE AND EMERGING TECHNOLOGIES PROGRAMME; 38, 34, 2: CRAIG MAXWELL, STYLED BY SHANNON AMOS/ARTIST UNTIED; 33: DALE GOLD; 35: EVERETT COLLECTIONS; 7: © 2005 ROSS-HIME DESIGNS; 25: GETTY; 19: LUCASFILM, INC.; 21: NASA AMES RESEARCH CENTER; 16: SPACE AND NAVAL WARFARE SYSTEMS CENTER, SAN DIEGO; 15: SCIENCE PHOTO LIBRARY; 10: COMPUTER HISTORY MUSEUM; 8: © 2006 INTUITIVE SURGICAL INC.; 3: NASA

01 Stanley

The Stanford Racing Team's autonomous vehicle is a modified Volkswagen Touareg that can scan any terrain and pick out a drivable course to a preset destination. Cup holders optional.



Stanford's souped-up Volkswagen blasted through the Mojave Desert, blew away the competition, and won Darpa's \$2 million Grand Challenge. Buckle up, human – the driverless car of the future is gaining on you.

Say Hello to Stanley

by Joshua Davis

ROBOT RACE CAR CHAMPION OF THE WORLD

Sebastian Thrun is sitting in the passenger seat of a 2004 Volkswagen Touareg that's trying to kill him.

The car hurtles down a rutted dirt road at 35 miles per hour somewhere in the Mojave Desert, bucking and swerving, kicking up a cloud of dust. Thrun, the youngest person ever to head Stanford's famed artificial intelligence laboratory, clings to an armrest. Mike Montemerlo, a speed-coding computer programmer and postdoc, is wedged in the backseat amid a tangle of wires and cables.

No one is driving. Or more precisely, the Touareg is trying to drive itself. But despite 635 pounds of gear – roof-mounted radar, laser range finders, video cameras, a seven-processor shock-mounted computer – the car is doing a lousy job. Thrun tightens his grip on the armrest. He's built plenty of robots, but he's never entrusted his life to one of his creations. He's scared, confused, and above all furious

that his algorithms are failing.

Suddenly the steering wheel spins itself hard to the left and the car speeds toward a ditch. David Stavens, a programmer who is stationed in the driver's seat in case of emergency, grabs the wheel and fights the pull of the robotic autopilot, which is insisting on a plunge into the gulley. Stavens slams his foot down on the computer-controlled brake. Thrun hits the big red button on the console that disables the vehicle's navigation computers. The SUV skids to a halt. "Hey, that was exciting," Thrun says, trying to sound upbeat.

It wasn't supposed to be this way. In 2003, the Defense Advanced Research Projects Agency offered \$1 million to anyone who could build a self-driving vehicle capable of navigating 300 miles of desert. Dubbed the Grand Challenge, the robot-vehicle race was hyped for months. It was going to be as important as the 1997 Kasparov-Deep Blue chess match. But on race day in March 2004, the

cars performed like frightened animals. One veered off the road to avoid a shadow. The largest vehicle – a 15-ton truck – mistook small bushes for enormous boulders and slowly backed away. The favorite was a CMU team that, fueled by multimillion-dollar military grants, had been working on unmanned vehicles for two decades. Its car went 7.4 miles, hit a berm, and caught fire. Not a single car finished.

Back at Stanford, Thrun logged on to check the progress of the race and couldn't believe what he was seeing. It was a humiliation for the entire field of robotics – a field Thrun was now at the center of. Only a year before, he'd been named head of Stanford's AI program. In the quiet halls of the university's Gates Computer Science Building, the suntanned 36-year-old German was a whirlwind of excitement, ideas, and brightly colored shirts. He was determined to show what intelligent machines could contribute to society. And though he had never considered building a self-driving car before, the sorry results of the first Grand

Challenge inspired him to give it a try.

He assembled a first-rate team of researchers, attracted the attention of Volkswagen's Palo Alto R&D team, and charged ahead. But here in the desert, he's facing the reality that the Touareg – dubbed Stanley, a nod to Stanford – is totally inadequate. With only three months to go before the second Grand Challenge, he realizes that some basic problems remain unsolved.

Thrun gets out to kick the dirt on the side of the road and think. While the car idles, he squints at the uneven terrain ahead. This was his chance to lead the way toward his vision of the new vehicular order. But for now, all he sees is mountains, sagebrush, and sky.

It started with a black-and-white videogame in 1979. Thrun, then 12, was spending most of his free time at a local pub in Hannover, Germany. The place had one of the first coin-operated videogames in town, and 20 pfennig bought him three lives driving at high speed through a stark





landscape of oil slicks and oncoming cars. It was thrilling – and much too expensive. For weeks, Thrun scrutinized the graphics and then decided that he could re-create the game on his Northstar Horizon, a primitive home computer that his father, a chemical engineer, had bought for him. He shut himself in his room and devoted his young life to coding the Northstar. It ran at 4 MHz and had only 16 Kbytes of RAM, but somehow he coaxed a driving game out of the machine.

Though he didn't study or do much homework over the next seven years, Thrun ended up graduating near the top of his high school class. He wasn't sure what was next. He figured he'd think about it during his mandatory two-year stint in the German army.

Team Stanley: But on June 15, 1986 – the last day to apply for university admissions – military authorities told him he wouldn't be

needed that year. Two hours later, he arrived at the centralized admission headquarters in Dortmund with only 20 minutes to file his application. The woman behind the counter asked him what he wanted to study – in Germany, students declare a major before arriving on campus. He looked down the list of options: law, medicine, engineering, and computer science. Though he didn't know much about computer science, he had fond memories of programming his Northstar. "Why not?" he thought, and decided his future by checking the box next to computer science.

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Within five years, he was a rising star in the field. After posting perfect scores on his final undergraduate exams, he went on to graduate school at the University of Bonn, where he wrote a paper showing for the first time how a robotic cart, in motion, could balance a pole. It revealed an instinct for creating robots that taught themselves.

The public accepts autopilot in the air. But on the ground?

He went on to code a bot that mapped obstacles in a nursing home and then alerted its elderly user to dangers. He programmed robots that slithered into abandoned mines and came back hours later with detailed maps of the interior. Roboticians in the US began to take note. Carnegie Mellon offered the 31-year-old a faculty position and then gave him an endowed chair. But he still hadn't found a research area to focus all his energy and skills on.

While Thrun was settling in at CMU, the hot topic in robotics was self-driving cars. The field was led by Ernst Dickmanns, a professor of aerospace technology at the University of the Bundeswehr. He liked to point out that planes had been flying themselves since the 1970s. The public was clearly willing to accept being flown by autopilot, but nobody had tried the same on the ground. Dickmanns decided to do something about that.

With help from the German military and Daimler-Benz, he spent seven years retrofitting a boxy Mercedes van, equipping it with video cameras and a bunch of early Intel processors. On a Daimler-Benz test track in December 1986, the driverless

van accelerated to 20 miles per hour and, using data supplied by the videocams, successfully stayed on a curving road. Though generally forgotten, this was the Kitty Hawk moment of autonomous driving.

It sparked a 10-year international dash to develop self-driving cars that could navigate city streets and freeways. In the

US, engineers at Carnegie Mellon led the charge with funding from the Army. On both sides of the Atlantic, the approach involved a data-intensive classification approach, a so-called rule-based system. The researchers assembled a list of easily identifiable objects (solid white lines, dotted white lines, trees, boulders) and told the car what to do when it encountered them. Before long, though, two main problems emerged. First, processing power was anemic, so the vehicle's computer quickly became overwhelmed when confronted with too much data (a boulder beside a tree, for instance). The car would slow to a crawl while trying to apply all the rules. Second, the team couldn't code for every combination of conditions. The real world of streets, intersections, alleys, and highways was too complex.

In 1991, a CMU computer science PhD student named Dean Pomerleau had a critical insight. The best way to teach cars to drive, he suspected, was to have them learn from the experts: humans. He got behind the wheel of CMU's sensor-covered, self-driving Humvee, flipped on all the computers, and ran a program that tracked his reactions as he sped down a freeway in

Pittsburgh. In minutes, the computers had developed algorithms that codified Pomerleau's driving decisions. He then let the Humvee take over. It calmly maneuvered itself on Pittsburgh's interstates at 55 miles per hour.

Everything worked perfectly until Pomerleau got to a bridge. The Humvee swerved dangerously, and he was forced to grab the wheel. It took him weeks of analyzing the data to figure out what had gone wrong: When he was "teaching" the car to drive, he had been on roads with grass alongside them. The computer had determined that this was among the most important factors in staying on the road: Keep the grass at a certain distance and all will be well. When the grass suddenly disappeared, the computer panicked.

It was a fundamental problem. In the mid-'90s, microchips weren't fast enough to process all the potential options, especially not at 55 miles per hour. In 1996, Dickmanns proclaimed that real-world autonomous driving could "only be realized with the increase in computer performance ... With Moore's law still valid, this means a time period of more than one decade." He was right, and everyone knew it. Research funding dried up, programs shut down, and autonomous driving receded back to the future.

Eight years later, when Darpa held its first Grand Challenge, processors had in fact become 25 times faster, outpacing Moore's law. Highly accurate GPS instruments had also become widely available. Laser sensors were more reliable and less expensive. Most of the conditions Dickmanns had said were necessary had been met or exceeded. More than 100 contestants signed up, including a resurgent CMU squad. Darpa officials couldn't hide their excitement. The breakthrough moment in autonomous driving was, they

thought, at hand. In truth, some of the field's biggest challenges had yet to be overcome.

Once Thrun decided to take a crack at the second Grand Challenge, he found himself consumed by the project. It was as though he were 12 again, shut up in his room, coding driving games. But this time a Northstar home computer wasn't going to cut it. He needed serious hardware and a sturdy vehicle.

That's when he got a call from Cedric Dupont, a scientist at Volkswagen's Electronics Research Laboratory, just a few miles from the Stanford campus. The Volkswagen researchers wanted in on the Grand Challenge. They'd heard that Thrun was planning to enter the event, and they offered him three Touaregs—one to race, another as a backup, and a third for spare parts. The VW lab would outfit them with steering, acceleration, and braking control systems custom-built to link to Thrun's computers. Thrun had his vehicle, and Volkswagen executives had a chance to be part of automotive history.

It was history, however, that Red Whittaker planned on writing himself. Whittaker, the imposing, bald, bombastic chief of CMU's eponymously named Red Team, had been working on self-driving vehicles since the '80s. Whittaker's approach to problem solving was to use as much technological and automotive firepower as possible. Until now, the firepower hadn't been enough. This time, he would make sure that it was.

First, he entered two vehicles in the race: a 1986 Humvee and a 1999 Hummer. Both were chosen for their ruggedness. Whittaker also stabilized the sensors on the trucks with gyroscopes to ensure more reliable data. Then he sent three men in a laser-studded, ground-scanning truck

into the desert for 28 days. Their mission: create a digital map of the race area's topography. The team logged 2,000 miles and built a detailed model of the desolate sagebrush expanses of the Mojave.

That was only the beginning. The Red Team purchased high-resolution satellite imagery of the desert and, when Darpa revealed the course on race day, Whittaker had 12 analysts in a tent beside the start line scrutinize the terrain. The analysts identified boulders, fence posts, and ditches so that the two vehicles would not have to wonder whether a fence was a fence. Humans would have already coded it into the map.

The CMU team also used Pomerleau's approach. They drove their Humvees through as many different types of desert terrain as they could find in an attempt to teach the vehicles how to handle varied environments. Both SUVs boasted seven Intel M processors and 40 Gbytes of flash memory –

enough to store a world road atlas. CMU had a budget of \$3 million. Given enough time, manpower, and access to the course, the CMU team could prepare their vehicles for any environment and drive safely through it.

It didn't cut it. Despite that 28-day, 2,000-mile sojourn in the desert, CMU's premapping operation overlapped with only 2 percent of the actual race course. The vehicles had to rely on their desert training sessions. But even those didn't fully deliver. A robot might, for example, learn what a tumbleweed looks like at 10 am, but with the movement of the sun and changing shadows, it might mistake that same tumbleweed for a boulder later in the day.

Thrun faced these same problems. Small bumps would rattle the Touareg's sensors, causing the onboard computer to swerve away from an imagined boulder. It couldn't distinguish between sensor error, new terrain, its own shadow, and the actual state of

the road. The robot just wasn't smart enough.

And then, as Thrun sat on the side of that rutted dirt road, an idea came to him. Maybe the problem was a lot simpler than everyone had been making it out to be. To date, cars had not critically assessed the data their sensors gathered. Researchers had instead devoted themselves to improving the quality of that data, either by stabilizing cameras, lasers, and radar with gyroscopes or by improving the software that interpreted the sensor data. Thrun realized that if cars were going to get smarter, they needed to appreciate how incomplete and ambiguous perception can be. They needed the algorithmic equivalent of self-awareness.

Together with Montemerlo, his lead programmer, Thrun set about recoding Stanley's brain. They asked the computer to assess each pixel of data generated by the sensors and then assign it an accuracy value based on how a human drove the

car through the desert. Rather than logging the identifying characteristics of the terrain, the computer was told to observe how its interpretation of the road either conformed to or varied from the way a human drove. The robot began to discard information it had previously accepted – it realized, for instance, that the bouncing of its sensors was just turbulence and did not indicate the sudden appearance of a boulder. It started to ignore shadows and accelerated along roads it had once perceived as being crisscrossed with ditches. Stanley began to drive like a human.

Thrun decided to take the car's newfound understanding of the world a step further. Stanley was equipped with two main types of sensors: laser range finders and video cameras. The lasers were good at sensing ground within 30 meters of the car, but beyond that the data quality deteriorated. The video camera was good at looking farther away but was less

HOW STANLEY SEES THE ROAD

The SUV's hard drives boot up, its sensors come to life, and it's ready to roll. Here's how Stanley works. – J.D.

1 GPS antenna

The rooftop GPS antenna receives data that has actually traveled twice into space – once to receive an initial position that is accurate up to a meter, and a second time to make corrections. The final reading is accurate up to 1 centimeter.

2 Laser Range Finder

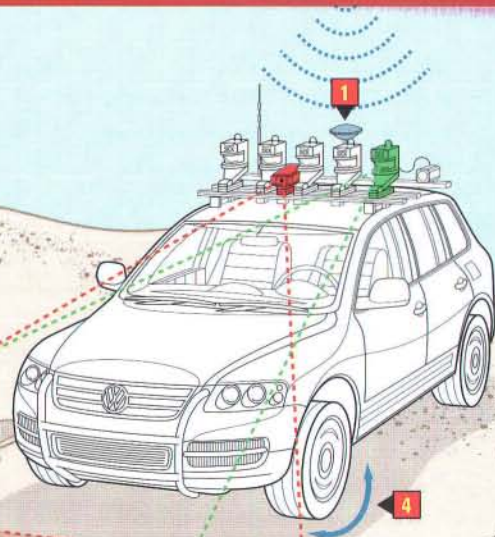
So-called lidar scans the terrain 30 meters ahead and to either side of the grill five times a second. The data is used to build a map of the road.

3 Video camera

The video camera scans the road beyond the lidar's range and pipes the data back to the computer. If the lasers have identified drivable ground, software looks for the same characteristics in the video data, extending Stanley's vision to 80 meters and permitting safe acceleration.

4 Odometry

To contend signals blocked by, say, a tunnel or mountain, a photo sensor in the wheel well monitors a pattern imprinted on Stanley's wheels. The data is used to determine how far Stanley has moved since the blackout. The onboard computer can then track the vehicle's position based on its last known GPS location.



accurate in the foreground. Maybe, Thrun thought, the laser's findings could inform how the computer interpreted the faraway video. If the laser identified drivable road, it could ask the video to search for similar patterns ahead. In other words, the computer could teach itself.

It worked. Stanley's vision extended far down the road now, allowing it to steer confidently at speeds of up to 45 miles per hour on dirt roads in the desert. And because of its ability to question its own data, the accuracy of Stanley's perception improved by four orders of magnitude. Before the recoding, Stanley incorrectly identified objects 12 percent of the time. After the recoding, the error rate dropped to 1 in 50,000.

It's half past 6 in the morning on October 8, 2005, outside of Primm, Nevada. Twenty-three vehicles are here for the second Grand Challenge. Festooned with corporate logos, lasers, radars, GPS transponders, and video cameras, they're parked on the edge of the gray-brown desert and ready to roll. The early morning light clashes with the garish glow of the nearby Buffalo Bill's Resort and Casino.

Red Whittaker is beaming. His 12 terrain analysts have completed their two-hour premapping of the route, and the data has been uploaded to the two CMU vehicles via a USB flash drive. The stakes are high this year: Darpa has doubled the prize money to \$2 million, and Whittaker is ready to win it and erase the memory of the 2004 debacle. Last night, he pointed out to the press that Thrun had been a junior faculty member in Whittaker's robotics lab at CMU. "My DNA is all over this race," he boasted. Thrun won't be baited by Whittaker's grandstanding. He focuses on trying to calm his own frayed nerves.

The race begins quietly: One

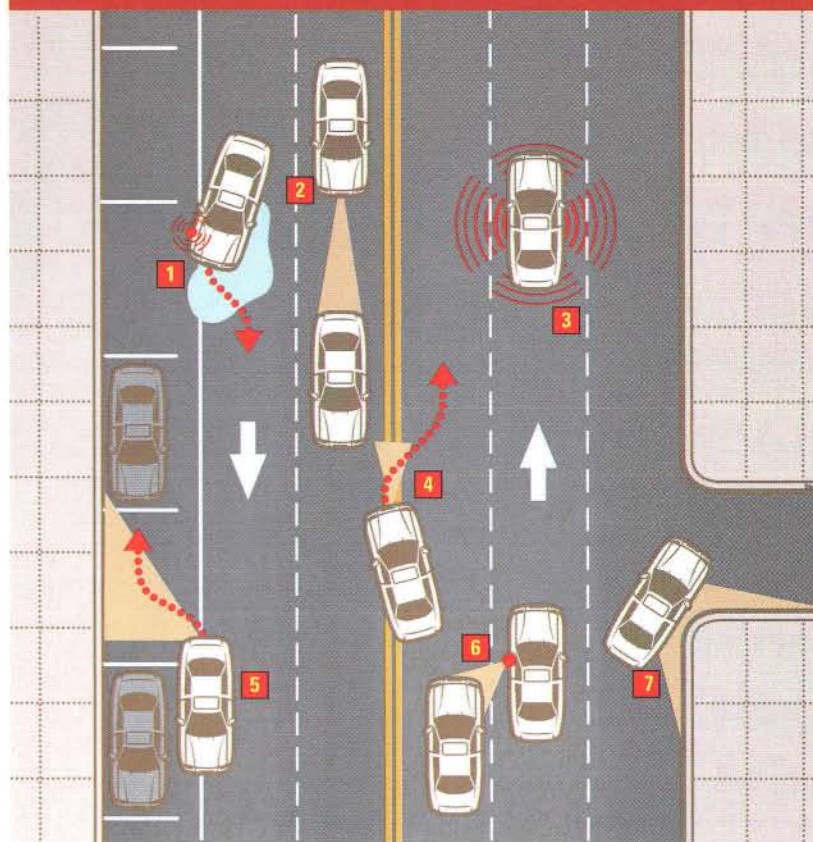
by one, the vehicles drive off into the hills. A few hours later, the critical moment is captured in grainy footage. CMU's H1 is in the middle of a dusty white desert expanse. The camera slowly approaches – the image is pixelated and overexposed. It's the view from Stanley's rooftop camera. For the past 100 miles, the Touareg has been tailgating the H1, and now it pulls close. Its lasers scan the exterior of its competitor, revealing a ghostly green outline of side panels and a giant, sensor-stabilizing gyroscope. And then the VW rotates its steering wheel and passes.

Darpa has imposed speed limits of 5 to 25 miles per hour, depending on conditions. Stanley wants to go faster. Its lasers are constantly teaching its video cameras how to identify drivable terrain, and it knows that it could accelerate more. For the rest of the race, Stanley pushes up against the speed limits as it navigates through open desert and curving mountain roads. After six hours of driving, it exits the final mountain pass ahead of every other team. When Stanley crosses the finish line, Thrun catches his first sight of an undiscovered country, a place where robots do all the driving.

The 128-mile race is a success. Four other vehicles, including both of CMU's entries, complete the course behind Stanley. The message is clear: Autonomous vehicles have arrived, and Stanley is their prophet. "This is a watershed moment – much more so than Deep Blue versus Kasparov," says Justin Rattner, Intel's R&D director. "Deep Blue was just processing power. It didn't think. Stanley thinks. We've moved away from rule-based thinking in artificial intelligence. The new paradigm is based on probabilities. It's based on statistical analysis of patterns. It is a better reflection

TAKING THE WHEEL

Seven ways today's cars are already robots. – Brian Lam



of how our minds work."

The breakthrough comes just as carmakers are embracing a host of self-driving technologies, many of them barely recognizable as robotic. Take, for example, a new feature known as adaptive cruise control, which allows the driver to select the distance to be maintained between the vehicle and the car in front of it. On the Toyota Sienna minivan, this is simply another button on the steering wheel. What that button represents, however, is a laser that surveys the distance to the vehicle ahead of it. The minivan's computer interprets the data and then controls the acceleration and braking to keep the distance constant. The computer has, in essence, taken over part of the driving.

But even as vehicles are being produced with sensors that perceive the world, they have, until now, lacked the intelligence to

comprehensively interpret what they see. Thanks to Thrun, that problem is being solved. Computers are nearly ready to take the wheel. But are humans ready to let them?

Jay Gowdy doesn't think so. A highly regarded roboticist, he has worked for nearly two decades to build self-driving cars, first with CMU and, more recently, with SAIC, a Fortune 500 defense contractor. He notes that in the US, about 43,000 people die in traffic accidents every year. Robot-driven cars would radically reduce the number of fatalities, he says, but there would still be accidents, and those deaths would be attributable to computer error. "The perception is that in the majority of accidents today, those who die are drunk, lazy, or stupid and bring it on themselves," Gowdy says. "If computers take over the driving, any deaths are likely to be per-

1 Road Condition Reporting

When a car using BMW's hazard system slips on ice, its sensors activate traction control. Meantime, wireless technology alerts other cars in the area to the hazard.

2 Adaptive Cruise Control

Luxury cars made by Audi, BMW, Infiniti, and others now use radar-guided cruise control to keep pace with the car ahead.

3 Omnidirectional Collision System

GM has built an inexpensive collision detection system that allows GPS-equipped cars to identify each other and communicate wirelessly.

4 Lane-Departure Prevention

Nissan has a prototype that uses cameras and software to detect white lines and reflective markers. If the system determines the vehicle is drifting, it will steer the car back into the proper lane.

5 Auto Parallel Park

Toyota has a technology that uses a camera to identify a curbside parking space and turns the wheel automatically to reverse you into the spot.

6 Blind-Spot Sensors

GM's GPS-based collision detectors can warn you when another car enters your blind spot.

7 Corner Speed

An experimental Honda navigation computer anticipates upcoming turns and, if necessary, slows the vehicle to match predetermined safe speeds.

ceived as the loss of people who did nothing wrong."

The resulting liability issues are a major hurdle. If a robotically driven car gets in an accident, who is to blame? If a software bug causes a car to swerve off the road, should the programmer be sued, or the manufacturer? Or is the accident victim at fault for accepting the driving decisions of the onboard computer? Would Ford or GM be to blame for selling a "faulty" product, even if, in the larger view, that product reduced traffic deaths by tens of thousands?

This morass of liability questions would need to be addressed before robot cars could be practical. And even then, Americans would have to be willing to give up control of the steering wheel.

Which is not something they're likely to do, even if it means saving 40,000 lives a year. So the challenge for carmakers will be

to develop interfaces that make people *feel* like they're in control even when the car is really doing most of the thinking. In other words, that small adaptive cruise control button in Toyota's minivan is a Trojan horse.

"OK, we're two of two, two of two, and one of one, no U-turn, speed advisory 25, large divider, POI gas station on left."

Michael Loconte and Bill Wong are creeping through a quiet suburb just north of San Jose, California. They are driving a white Ford Taurus with a 6-inch antenna on the roof. Loconte wears a headset and mumbles coded descriptions of the surroundings into the microphone – "two of two" means that he's in the right lane on a street with two lanes, and "POI" means point of interest. Wong scribbles with a digital pen, making landmark and street address notations on a scrolling map.

"People think we're with the CIA," Loconte says. "I know it kind of looks like that."

But they aren't spies. They're field analysts working for the GPS mapping company Navteq, and they're laying the foundation for the future of driving. On this Friday afternoon, they're doing a huge commercial extension of CMU's ditch-and-fence mapping operation. Navteq has 500 such analysts driving US neighborhoods, mapping them foot by foot. Though Thrun has proven that extensive mapping isn't needed to get from A to B, maps are critical when it comes to communicating with robotic vehicles. As automotive engineers build cars with increasing autonomy, the human interface with the vehicle will migrate from the steering wheel to the map. Instead of turning a wheel, drivers will make decisions by touching destinations on an interactive display.

"We want to move up the food chain," says Bob Denaro, Navteq's VP of business development. The company sees itself moving beyond the help-me-I'm-lost gizmo business and into the center of the new driving experience. That's not to say that the steering wheel will disappear; it will just be gradually de-emphasized. We will continue to sit in the driver's seat and have the option of intervening if we choose. As Denaro notes: "A person's role in the car is changing. People will become more planners than drivers."

And why not – since the car is going to be a better driver than a human anyway. With the addition of map information, a car will know the angle of a turn that's still 300 feet away. Navteq is in the process of collecting slope information, road width, and speed limits – all things that bathe the vehicle in more data than a human could ever handle.

Denaro believes that the key to making people comfortable with the shift from driver to planner will be the same thing that made pilots comfortable accepting autopilot in the cockpit: situational awareness. If a robot simply says it wants to go left instead of right, we feel uncomfortable. But if a map showed a traffic jam to the right and the machine listed reasons for rerouting, then we would have no problem pressing the Accept Route Change icon. We feel like we are still in control.

"Autopilot in the cockpit greatly extended the pilots' skills," Denaro says. Automation in driving will do the same thing.

Sebastian Thrun is standing in front of about a hundred of his colleagues and teammates at a winery overlooking Silicon Valley. He has a glass of champagne in one hand and a microphone in the other, and everyone is in a festive mood. Darpa just gave Stanford a \$2 million check for winning the desert race, and Thrun is going to use a portion of the money to endow the Stanley fellowship for graduate students in computer science.

"Some people refer to us as the Wright brothers," he says, holding up his champagne. "But I prefer to think of us as Charles Lindbergh, because he was better-looking."

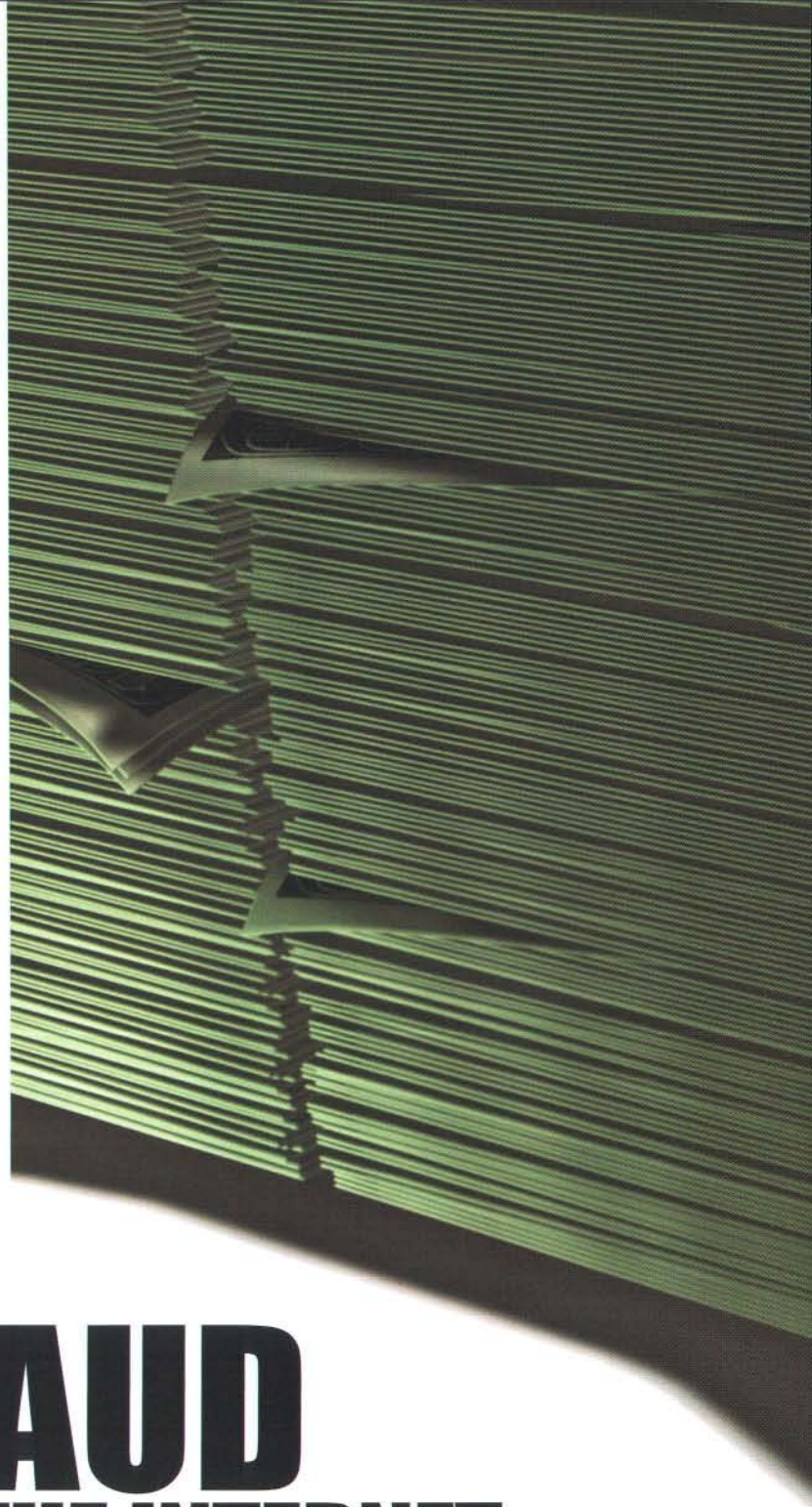
Everyone laughs and toasts to that. "A year ago, people said this couldn't be done," Thrun continues. "Now everything is possible." There is more applause, and then the AI experts, programmers, and engineers take small, conservative sips of the champagne. The drive home is curvy and dark. If only the party were happening in Thrun's future – then the champagne could flow unimpeded and the cars would take everyone safely home. ■ ■ ■

Stuart Cauff launched a charter-jet service in Miami Beach back in 2002. Being a 21st-century business, JetNetwork advertised on the Internet, especially on search engines. Anyone who Googled, say, "air charter Miami" would be greeted with the familiar list of search results and, in a separate place, a plain box of text with a blue hyperlink to JetNetwork's Web site.

Search ads were perfect for Cauff's business. His potential customers – a diverse group of celebrities, photojournalists, medical evacuees, and people who just needed to get away from or to Miami in a hurry – were scattered across the country. To reach this audience with traditional advertising, he would have had to buy time on scores of television and radio stations and space in just as many newspapers and magazines, something that only wealthy, established companies could afford. Even if Cauff could pay for the ads, the vast majority of people exposed to them wouldn't care about charter jets, so most of his money would be wasted. But with search-based ads, JetNetwork's name would appear, at least in theory, only before people who were actually interested in Miami charter flights.

Still, the ads were expensive. This kind of advertising is known as pay-per-click, because advertisers shell out money to a search engine every time a surfer clicks on their links. The price and placement depend mainly on how much the advertiser wants to bid for the search term – also known as the keyword in ad jargon. As other charter-air companies began PPC advertising, the cost of a click on a top-ranked ad rose to about \$10 – in some cases as high as \$30 – and there could be hundreds of clicks a month.

Which is why Cauff was infuriated when he discovered that up to "40 percent, maybe more" of the clicks on his keyword ads apparently came not from potential customers around the nation but from a single Internet address, one that belonged to a rival based in New York City. "If we get clicked fraudulently, it uses up our ad budget," he says. Advertisers usually set limits on how much they will spend, and search engines drop ads once they hit that limit. As a result, fraudulent



HOW CLICK FRAUD COULD SWALLOW THE INTERNET

Pay-per-click advertising is big, big, big business. So are bogus hits on Internet ads. It's search giants against scam artists in an arms race that could crash the entire online economy.

by Charles C. Mann illustration by Mirko Ilic



clicking "literally pushes us off the page," Cauff explains. "And then our competition buys in at a lower price when we're not there."

Cauff was a victim of "click fraud," the illicit manipulation of keyword-based advertising. In this case, the scam appeared straightforward – one company clicked on a rival's search engine ads to drive up its costs. More complex is a second type of bogus ad click that exploits a second form of PPC advertising: ads fed to Web sites – anything from personal blogs to the sites of major corporations – by search providers like Google, Yahoo!, LookSmart, and, soon, MSN. The search engine indexes the content of the Web site and matches it with a group of relevant ads. (The most familiar form is Google's AdSense program – the sets of links labeled ADS BY GOOGLE that show up on pages across the Internet. The advertisements that appear on Google itself are part of a separate but related program called AdWords.) Thus, bloggers who write about their air-travel experiences and choose to host such ads may find links on their pages for JetNetworks and its brethren. If a blog visitor clicks on the ad, the search engine splits its fee with the blogger. Although these "affiliate" ads have been hugely successful for advertisers, search engines, and the host Web sites, the system creates an incentive for affiliates to cheat. "All you have to do to make some money is find a way to click the ad sent by Google or Yahoo! to your own Web page," says search marketing consultant Joseph Holcomb. "Click! – there's 10 bucks. Click! – there's 10 bucks. It goes on all the time."

Pay-per-click is the fastest-growing segment of all advertising, reports the Interactive Advertising Bureau. Last year, Yahoo! alone ran more than 250 million individual listings, according to Michael Egan, the company's search-marketing director of content strategy. Yahoo! doesn't break out PPC earnings separately in its financial statements, but Goldman Sachs analyst Anthony Noto believes that keyword advertising accounted for about half of the company's estimated \$3.7 billion in revenue for 2005. PPC is even more lucrative for Google. According to Noto, Google will end 2005 with \$6.1 billion in revenue. About 99 percent of that revenue comes from keyword ads (over

THE "AFFILIATE" AD SYSTEM CREATES A HUGE INCENTIVE TO CHEAT.

56 percent from AdWords, according to the company's most recent quarterly financial statement, and 43 percent from AdSense), making Google a bigger recipient of ad dollars than any television network or newspaper chain. All of which is to say that little blue text links, a type of advertising that barely existed five years ago, are poised to become the single most important form of marketing in the US – unless click fraud ruins it.

If that occurs, the consequences will be felt throughout the Net. By splitting revenue with the sites that host the ads, search engines have become, in effect, the Internet's venture capitalists, funding the content that attracts people to the computer screen. Unlike the VCs who backed the boom-era Internet, search engines now provide revenue to thousands of wildly diverse sites at little up-front cost to them – PPC advertising is one of the few income sources available to

bloggers, for instance. If rampant click fraud overwhelms the system, it will muffle the Internet's fabulous cacophony of voices.

The amount of click fraud is difficult to quantify; estimates of the proportion of fake clicks run from as low as 1 in 10 to as high as 1 in 2. In a widely cited recent study, MarketingExperiments.com, an online marketing research outfit, reported that "as much as 29.5 percent" of the clicks in three experimental PPC campaigns on Google were fraudulent. Whatever the exact figure, click fraud has become pervasive, and Google, Yahoo!, and the other major PPC firms have found themselves caught in a game of cat and mouse with its perpetrators. Even as the search engines shore up their defenses, click scammers are becoming more sophisticated, increasingly deploying complex software to disguise the origins of clicks. For now, the search companies and many of their clients maintain that the problem on their networks is under control. But some observers, like Holcomb, believe that click fraud is "a billion-dollar mess" that "has the potential of destroying the entire industry."

Last October, Boris Elpiner noticed something odd about the Web traffic coming to his company from its PPC ads. As vice president of marketing for RingCentral, an online telecommunications firm in San Mateo, California, Elpiner is in charge of its affiliate-ad program, which hired Yahoo! to distribute RingCentral's ads onto Web sites with compatible content. Poring over his records, he discovered that a keyword term ("fax software download") that had previously generated almost no clicks was suddenly pulling them in. The total cost to RingCentral for the clicks – \$2,500 over about four weeks – "was significant, but not immediately noticeable."

Puzzled by the sudden change, Elpiner investigated further. When users visit a Web site, the site server notes the URLs from which they came, the visitors' IP addresses, and other data. Cauff, the charter-jet executive, had used such information to conclude that a competitor was clicking repeatedly on his ads. In this case, Elpiner didn't see an obvious pattern. At the same time, the URLs and IP addresses associated with the suspect clicks "didn't make any sense," he says. "Some of the URLs were error 404 messages, and a lot of the addresses didn't exist."

Elpiner took the matter to Yahoo!, whose analysts "figured it all out quickly," he says. One or more Yahoo! affiliates may have generated deceptive clicks on ads served to their sites, using special software to disguise the source. The scammers, he says, "were clever enough not to take a whole lot from [the ads on] one site, but must have been trying to siphon off a little from many advertisers." Yahoo! gave Elpiner full credit. But it did not, as far as he could tell, try to identify the perpetrators. Instead, Yahoo! and other PPC companies are responding to click fraud by deploying new antifraud technologies. For example, Yahoo! analysts have created click fraud filters – algorithmic screens that sift through the sea of incoming clicks to find patterns suggesting fraud and then discard phony clicks without regard to source or motive.

Although Google and Yahoo! will not, for security reasons, discuss their methods in detail, the advertisements themselves offer some clues. When affiliates sign up for a box of, say, Google ads, they are essentially hosting within their own Web page a small, separate page with its own, very long URL. According to Joseph Tierney, an Internet

Contributing editor Charles C. Mann (www.charlesmann.org) is the author of 1491: New Revelations of the Americas Before Columbus.

marketer in central Florida who describes himself as a repentant click fraudster, that URL is embedded with a string of information including the time, in milliseconds; the last time the host Web page was updated, also in milliseconds; and other data used to track customer behavior. Analysts could use this material to match the various time stamps against one another, as well as other information provided by server logs. "If someone from such-and-such IP address clicks on the same ad four times in a second," says Elias Levy, a security architect at Symantec, "you can know that at least three of those clicks don't mean anything. It's inconceivable that Google wouldn't be looking at this."

The company won't confirm it, though. "We don't discuss our techniques," says Shuman Ghosemajumder, a Google business product strategy manager. Nor will Google disclose whether invalid clicks are common or whether it has "a lot" or "just a few" researchers working on click fraud. "We have recognized invalid clicks as a serious problem from the beginning," Ghosemajumder says. "We've done a good job at being effective with these issues in the past, and we believe we will be effective in the future." In his view, PPC companies should be judged not by whether they have succeeded in stamping out click fraud but by whether their advertisers are satisfied.

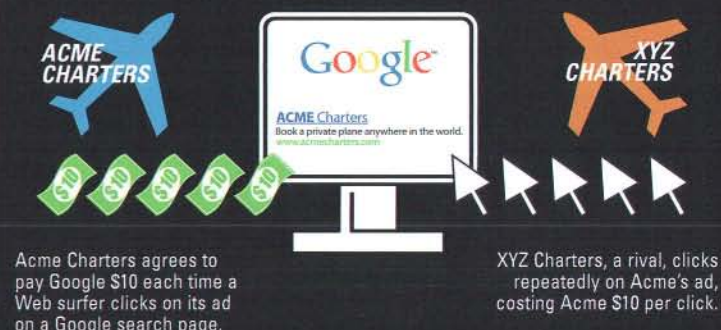
By that standard, Google and company seem largely successful, at least for now. Google is "very good at detecting multiple clicks from the same computer," says Ash Nallawalla, a former search engine advertising consultant in Melbourne, Australia. "I am not likely to be charged for any of those clicks, not even the first one." (Marketers contacted by *Wired* say much the same about Yahoo!) Google typically knocks about a third off the Chase Law Group's bill to discount for click fraud, according to James Butler, IT director for the Los Angeles-based firm, which draws about 60 percent of its clients through Internet advertising. "If we get 500 clicks from their ads," he says, "they bill us for 320 or so."

Not every customer comes away satisfied, though. Last summer Nathan McKelvey, president of the rent-a-jet firm CharterAuction.com in Quincy, Massachusetts, discovered an old server in his office with records of every visitor to his company's Web site since 2002. Many of the visits came through Google's and Yahoo!'s PPC programs. But a substantial number of those clicks came from Denmark, a country where CharterAuction did "exactly zero" of its business. When McKelvey asked Google and Yahoo! precisely which clicks he'd been billed for, neither company would tell him. All they'd reveal was how many clicks he'd paid for – not which ones or where they originated. Feeling stonewalled, he had his lawyer send a letter demanding refunds from both. "I have the strong suspicion," he says, "that we spent more than a quarter of a million dollars over a couple years on invalid clicks." According to McKelvey, the two companies have refused to refund his money or divulge further information. Google won't comment on specific actions with clients; Yahoo! says it is investigating the charges.

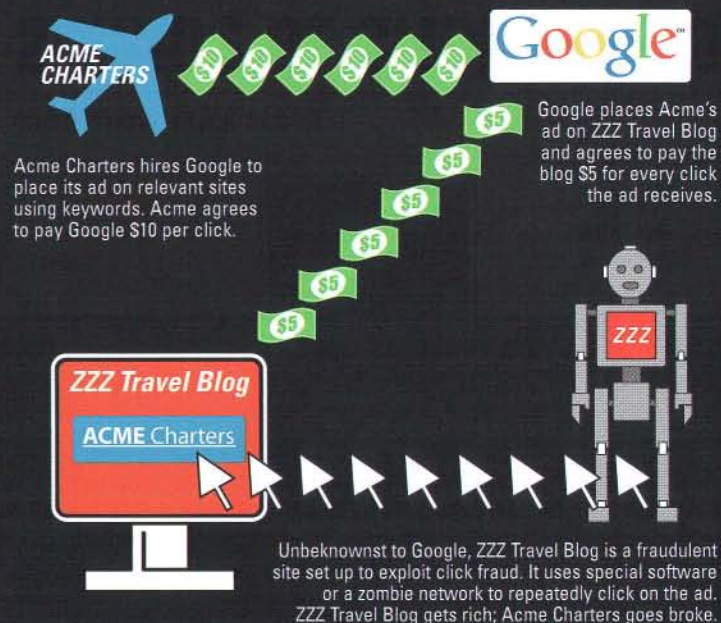
PPC companies may have to become more transparent to retain customer confidence, because click fraud has mutated into new, more complex forms. Responding to the demand for fake clicks, shady firms in India created click farms, facilities in which marginally employed people click on advertisements round the clock (these seem to have diminished in number or gone underground since 2004, when the *Times of India* revealed their existence). Companies also have begun attacking rivals with "impression fraud" – repeatedly reloading a search engine page where the rival's ad appears, without clicking on it, in order to eliminate it. (Google and Yahoo! routinely take steps

2 KINDS OF CLICK FRAUD

COMPETITIVE CLICK FRAUD



AFFILIATE CLICK FRAUD



to drop nonperforming ads.) In 2004, a programmer named Michael Bradley allegedly wrote click fraud software that disguised clicks' origins. He was arrested by the Secret Service and charged with attempting to extort \$100,000 from Google by threatening to release the software on the Internet; a trial is pending. The action did not eliminate this kind of software – it is now readily available on the Net.

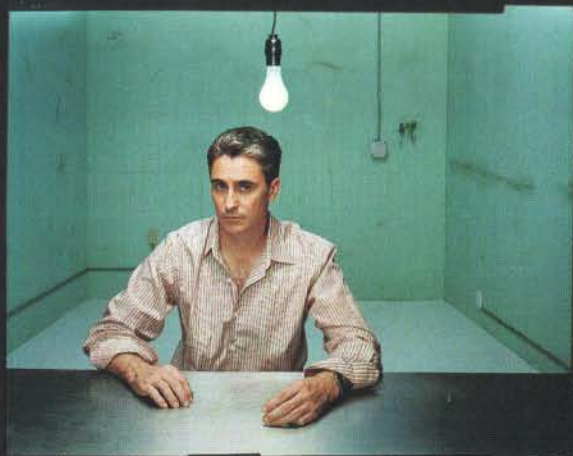
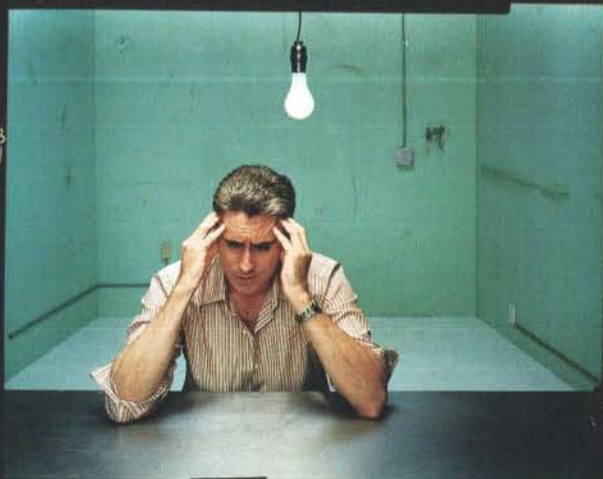
Other enterprising scammers manipulate the affiliate system by creating phony blogs – spam blogs, or splogs – that automatically generate content by continually copying bits from other Web sites, mixing in popular keywords, then signing up the resulting mélange as a Google or Yahoo! affiliate. By using software to link themselves repeatedly to well-known real blogs, splogs trick search engines into listing them high on their results list, thus generating traffic, which in turn generates ad clicks. When unsuspecting Internet searchers visit splogs, they end up clicking the ad links in a frustrated attempt to find some coherent text. Thousands of splogs exist, snarling the blogosphere – and the search engines that index it – in spam. 149

DON'T EVEN THINK ABOUT LYING

I'm flat on my back in a very loud machine, trying to keep my mind quiet. It's not easy. The inside of an fMRI scanner is narrow and dark, with only a sliver of the world visible in a tilted mirror above my eyes. Despite a set of earplugs, I'm bathed in a dull roar punctuated by a racket like a dryer full of sneakers.

Functional magnetic resonance imaging – fMRI for short – enables researchers to create maps of the brain's networks in action as they process thoughts, sensations, memories, and motor commands. Since its debut in experimental medicine 10 years ago, functional imaging has opened a window onto the cognitive operations behind such complex and subtle behavior as feeling transported by a piece of music or recognizing the face of a loved one in a crowd. As it migrates into clinical practice, fMRI is making it possible for neurologists to detect early signs of Alzheimer's disease and other disorders, evaluate drug treatments, and pinpoint tissue housing critical abilities like speech before venturing into a patient's brain with a scalpel.

Now fMRI is also poised to transform the security industry, the judicial system, and our fundamental notions of privacy. I'm in a lab at Columbia University, where scientists are using the technology to analyze the cognitive differences between truth and lies. By mapping the neural circuits behind deception, researchers are turning fMRI into a new kind of lie detector that's more probing and accurate than the polygraph, the standard lie-



3
2

KODAK 160NC 2401

How brain scans are reinventing the science of lie detection.

by STEVE SILBERMAN
photographs by JOHN MIDGLEY



When someone is telling the truth, the areas of the brain shown here in green become active. If he is lying, the parts of the brain shown in red display even more activity.

30

KODAK 160NC 2401



Psychologist Daniel Langleben used fMRI to find a "neurophysiological difference between deception and truth."

detection tool employed by law enforcement and intelligence agencies for nearly a century.

The polygraph is widely considered unreliable in scientific circles, partly because its effectiveness depends heavily on the intimidation skills of the interrogator. What a polygraph actually measures is the stress of telling a lie, as reflected in accelerated heart rate, rapid breathing, rising blood pressure, and increased sweating. Sociopaths who don't feel guilt and people who learn to inhibit their reactions to stress can slip through a polygrapher's net. Gary Ridgway, known as the Green River Killer, and CIA double agent Aldrich Ames

passed polygraph tests and resumed their criminal activities. While evidence based on polygraph tests is barred from most US trials, the device is being used more frequently in parole and child-custody hearings and as a counterintelligence tool in the war on terrorism. Researchers believe that fMRI should be tougher to outwit because it detects something much harder to suppress: neurological evidence of the decision to lie.

My host for the morning's experiment is Joy Hirsch, a neuroscientist and founder of Columbia's fMRI Research Center, who has offered me time in the scanner as a preview of the near future. Later

this year, two startups will launch commercial fMRI lie-detection services, marketed initially to individuals who believe they've been unjustly charged with a crime. The first phase of today's procedure is a baseline interval that maps the activity of my brain at rest. Then the "truth" phase begins. Prompted by a signal in the mirror, I launch into an internal monologue about the intimate details of my personal life. I don't speak aloud, because even little movements of my head would disrupt the scan. I focus instead on forming the words clearly and calmly in my mind, as if to a telepathic inquisitor.

Then, after another signal, I start to lie: *I've never been*

married. I had a girlfriend named Linda in high school back in Texas. I remember standing at the door of her parents' house the night she broke up with me. In fact, I grew up in New Jersey, didn't have my first relationship until I went to college, and have been happily married since 2003. I plunge deeper and deeper into confabulation, recalling incidents that never happened, while trying to make the events seem utterly plausible.

I'm relieved when the experiment is over and I'm alone again in the privacy of my thoughts. After an hour of data crunching, Hirsch announces, "I've got a brain for you." She lays out two sets of images, one labeled TRUTH and the other DECEPTION, and gives me a guided tour of my own neural networks, complete with circles and Post-it arrows.

"This is a very, very clear single-case experiment," she says. In both sets of images, the areas of my cortex devoted to language lit up during my inner monologues. But there is more activity on the deception scans, as if my mind had to work harder to generate the fictitious narrative. Crucially, the areas of my brain associated with emotion, conflict, and cognitive control – the amygdala, rostral cingulate, caudate, and thalamus – were "hot" when I was lying but "cold" when I was telling the truth.

"The caudate is your inner editor, helping you manage the conflict between telling the truth and creating the lie," Hirsch explains. "Look here – when you're telling the truth, this area is asleep. But when you're trying to deceive, the signals are loud and clear."

I not only failed to fool the invisible inquisitor, I managed to incriminate myself without even opening my mouth.

Contributing editor Steve Silberman (digaman@wiredmag.com) wrote about filmmaker George Lucas in issue 13.05.

The science behind fMRI lie detection has matured with astonishing speed. The notion of mapping regions of the brain that become active during deception first appeared in obscure radiology journals less than five years ago. The purpose of these studies was not to create a better lie detector but simply to understand how the brain works.

One of the pioneers in the field is Daniel Langleben, a psychiatrist at the University of Pennsylvania. Back in 1999, he was at Stanford, examining the effects of a drug on the brains of boys diagnosed with attention deficit hyperactivity disorder. He had read a paper theorizing that kids with ADHD have difficulty lying. In Langleben's experience, however, they were fully capable of lying. But they would often make socially awkward statements because "they had a problem inhibiting the truth," he says. "They would just blurt things out."

Langleben developed a hypothesis that in order to formulate a lie, the brain first had to stop itself from telling the truth, then generate the deception – a process that could be mapped with a scanner.

Functional imaging makes cognitive operations visible by using a powerful magnetic field to track fluctuations in blood flow to groups of neurons as they fire. It reveals the pathways that thoughts have taken through the brain, like footprints in wet sand.

When Langleben ran an online search for studies of deception using fMRI, however, he found nothing. He was surprised to find "such a low-hanging fruit," as he puts it, still untouched in the hothouse of researchers hungry to find applications for functional imaging.

After taking a job at the University of Pennsylvania School of Medicine later that year, he

mapped the brains of undergraduates who had been instructed to lie about whether a playing card displayed on a computer screen was the same one they'd been given in an envelope along with \$20. The volunteers – who responded by pressing a button on a handheld device so they wouldn't have to speak – were told that if they "fooled" the computer, they could keep the money. Langleben concluded in 2002 in a journal called *NeuroImage* that there is "a neurophysiological difference between deception and truth" that can be detected with fMRI.

As it turned out, other researchers in labs across the globe were already reaching for the same fruit. Around the same time, a UK psychiatrist named Sean Spence reported that areas of the prefrontal cortex lit up on fMRI when his subjects lied in response to questions about what they had

She points to my fMRIs and four telltale hot spots in my neurocircuits, proof that I'm lying.

done that day. Researchers from the University of Hong Kong provided additional confirmation of a distinctive set of neurocircuits involved in deception.

For fMRI early adopters, these breakthroughs validated the practical value of functional imaging itself. "I felt this was one of the first fMRI applications with real value and global interest," Langleben says. "It had implications in crime and society at large, in defense, and even for the insurance industry."

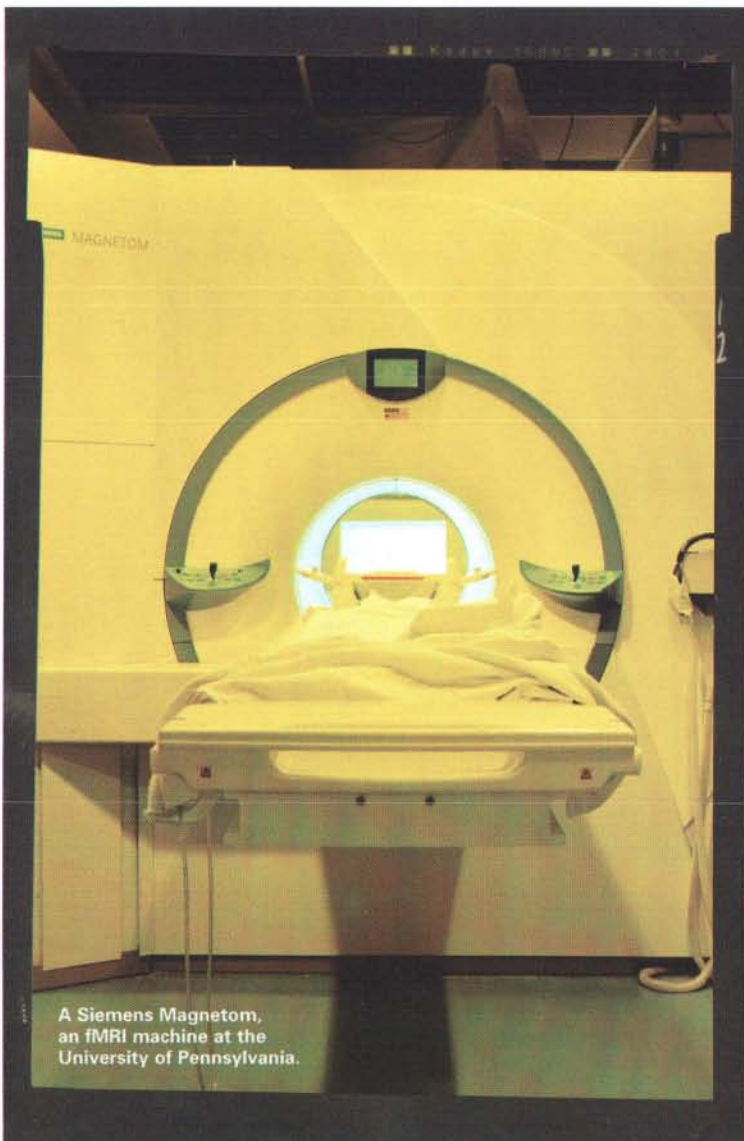
The subject took on a new urgency after 9/11 as security shot to the top of the national agenda. Despite questions about reliability, the use of polygraph machines

grew rapidly, both domestically – where the device is employed to evaluate government workers for security clearances – and in places like Iraq and Afghanistan, where Defense Department polygraphers are deployed to extract confessions, check claims about weapons of mass destruction, confirm the loyalty of coalition officers, and grill spies.

The need for a better way to assess credibility was underscored by a 2002 report, *The Polygraph and Lie Detection*, by the National Research Council. After analyzing decades of polygraph use by the Pentagon and the FBI, the council concluded that the device was still too unreli-

able to be used for personnel screening at national labs. Stephen Fienberg, the scientist who led the evaluation committee, warned: "Either too many loyal employees may be falsely judged as deceptive, or too many major security threats could go undetected. National security is too important to be left to such a blunt instrument." The committee recommended the vigorous pursuit of other methods of lie detection, including fMRI.

"The whole area of research around deception and credibility assessment had been minimal, to say the least, over the last half-century," says Andrew Ryan, head of research at the Department of



THE CORTEX COP

Your flight is now boarding. Please walk through the “mental detector.”

For all the promise of fMRI lie detection, some practical obstacles stand in the way of its widespread use: The scanners are huge and therefore not portable, and a slight shake of the head – let alone outright refusal to be scanned – can disrupt the procedure. Britton Chance, a professor emeritus of biophysics at the University of Pennsylvania, has developed an instrument that records much of the same brain activity as fMRI lie detection – but fits in a briefcase and can be deployed on an unwilling subject.

Chance has spent his life chasing and quantifying elusive signals – electromagnetic, optical, chemical, and biological. During the Second World War, he led the team at the MIT Radiation Lab that helped develop military radar and incorporated analog computers into the ranging system of bombers. In the 1970s, long before the invention of fMRI, Chance began using a related technique called

magnetic-resonance spectroscopy to study living tissue. The first functionally imaged brain was that of a hedgehog in one of his experiments. Now 92, Chance still rides his bike to the university six days a week to teach and work in his lab. His mind is as acute as ever. After glancing through a book to confirm a data point, he resumes the conversation by saying, “I’m back online.”

He explains that his goal is to create a wearable device “that lets me know what you’re thinking without you telling me. If I ask you a question, I’d like to know before you answer whether you’re going to be truthful.”

To map neural activity without fMRI, Chance uses beams of near-infrared light that pass harmlessly through the forehead and skull, penetrating the first few centimeters of cortical tissue. There the light bounces off the same changes in blood flow tracked by fMRI. When it reemerges from the cra-

nium, this light can be captured by optical sensors, filtered for the “noise” of light in the room, and used to generate scans.

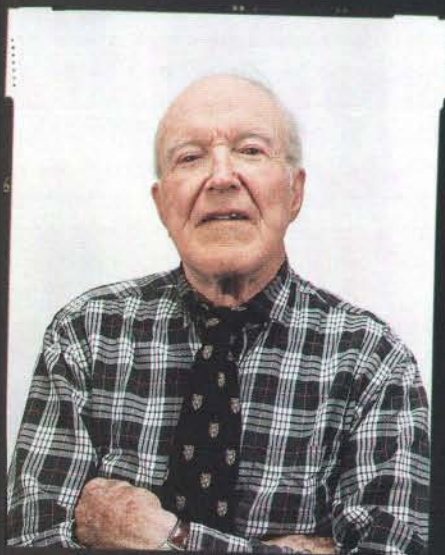
Though near-infrared light doesn’t penetrate the brain as deeply as magnetic resonance, some of the key signatures of deception mapped by fMRI researchers occur in the prefrontal cortex, just behind the forehead. The first iteration of Chance’s lie detector consisted of a Velcro headband studded with LEDs and silicon diode sensors. Strapping these headbands on 21 subjects in a card-bluffing experiment in 2004, a neuroscientist at Drexel named Scott Bunce was able to accurately detect lying 95 percent of the time. The next step, Chance says, is to develop a system that can be used discreetly in airports and security checkpoints for “remote sensing” of brain activity. This technology could be deployed to check for deception during standard question-and-answer exchanges (for

example, “Has anyone else handled your luggage?”) with passengers before boarding a plane, or during interviews with those who have been singled out for individual searches.

With funding from the Office of Naval Research, Chance and his colleagues are working to replace the LED headband with an invisible laser and a hypersensitive photon collector to create a system that can pick up the neural signals of deception from across a room.

Before undertaking this project, Chance consulted with Arthur Caplan, director of Penn’s Center for Bioethics. “Dr. Chance was a little uneasy about it,” Caplan recalls. “But there are certain public places where we lose the right to privacy as a condition of entering the building. Airport security staff is allowed to search your bag, your possessions, and even your body. In my view, there’s no blanket rule that says it’s always wrong to scan someone without their consent. What we need is a set of policies to determine when you *have* to have consent.”

Chance believes the virtues of what he calls “a network to detect malevolence” outweigh the impact on personal liberties. “It would certainly represent an invasion of privacy,” he says. “I’m sure there may be people who, for very good reasons, would not want to come near this device – and they’re the interesting ones. But we’ll all feel a bit safer if this kind of technology is used in places like airports. If you don’t want to take the test, you can turn around and fly another day.” Then he smiles. “Of course, that’s the biggest selector of guilt you could want.” – S.S.



Britton Chance is developing a wearable lie detector that fits in a suitcase. Next step: a scanner that works remotely.



"When you're trying to deceive," says neuroscientist Joy Hirsch, "the signals are loud and clear."

Defense Polygraph Institute. DoDPI put out a call for funding requests to scientists investigating lie detection, noting that "central nervous system activity related to deception may ... prove to be a viable area of research." Grants from DoDPI, the Department of Homeland Security, Darpa, and other agencies triggered a wave of research into new lie-detection technologies. "When I took this job in 1999, we could count the labs dedicated to the detection of deception on one hand," Ryan says. "Post-2001, there are 50 labs in the US alone doing this kind of work."

Through their grants, federal agencies began to influence the direction of the research. The early studies focused on discovering "underlying principles," as Columbia's Hirsch puts it – the basic neuromechanisms shared by all acts of deception – by averaging data obtained from scanning many subjects. But once government agencies like DoDPI started looking into fMRI, what began as an exploration of the brain became a race to build a better lie detector.

Paul Root Wolpe, a senior fellow at the Center for Bioethics at the University of Pennsylvania, tracks the development of lie-detection technologies. He calls the accel-

erated advances in fMRI "a textbook example of how something can be pushed forward by the convergence of basic science, the government directing research through funding, and special interests who desire a particular technology."

Langleben's team, whose work was funded partially by Darpa, began focusing more on detecting individual liars and less on broader psychological issues raised by the discovery of deception networks in the brain. "I wanted to take the research in that direction, but I was hell-bent on building a lie detector, because that's where our funders wanted us to go," he says.

To eliminate one major source of polygraph error – the subjectivity of the human examiner – Langleben and his colleagues developed pattern-recognition algorithms that identify deception in individual subjects by comparing their brain scans with those in a database of known liars. In 2005, both Langleben's lab and a DoDPI-funded team led by Andrew Kozel at the Medical University of South Carolina announced that their algorithms had been able to reliably identify lies.

By the end of 2006, two companies, No Lie MRI and Cephos, will bring fMRI's ability to detect deception to market. Both startups originated in the world of medical diagnostics. Cephos founder Steven Laken helped

A bomb has been planted. Do you want to trust something as unreliable as a polygraph or torture?

develop the first commercial DNA test for colorectal cancer. "fMRI lie detection is where DNA diagnostics were 10 or 15 years ago," he says. "The biggest challenge is that this is new to a lot of different groups of people. You have to get lawyers and district attorneys to understand this isn't a polygraph. I view it as no different than developing a diagnostic test."

Laken got interested in marketing a new technology for lie detection when he heard about the number of prisoners being held without charges at the US base in Guantánamo Bay, Cuba. "If these detainees have information we haven't been able to extract that could prevent another

9/11, I think most Americans would agree that we should be doing whatever it takes to extract it," he says. "On the other hand, if they have no information, detaining them is a gross violation of human rights. My idea was that there has to be a better way of determining whether someone has useful information than torture or the polygraph."

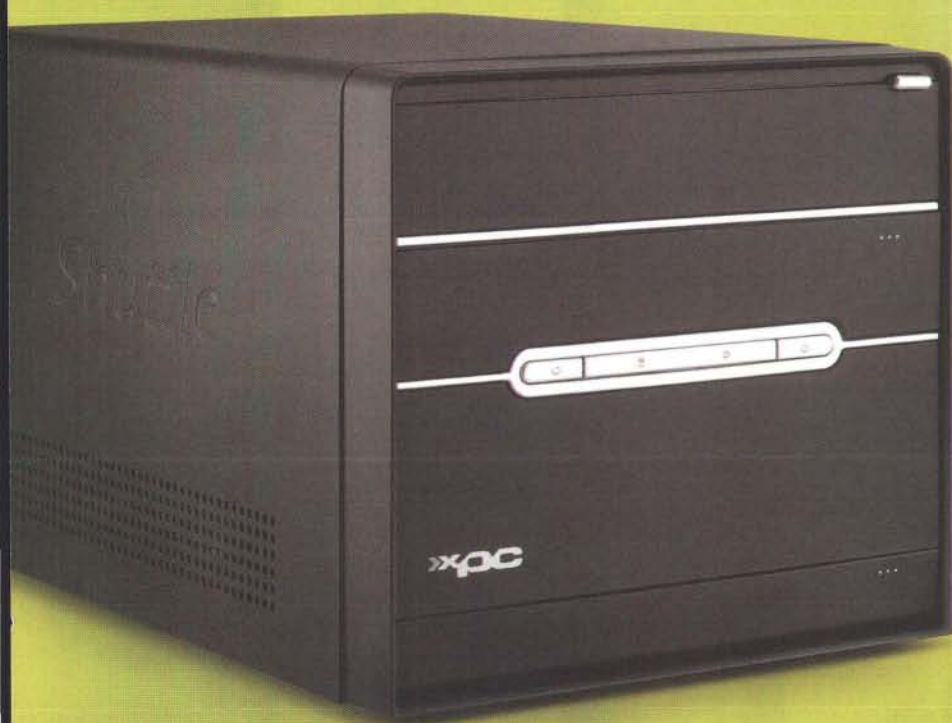
Cephos' lie-detection technology will employ the patents and algorithms developed by Kozel's team in South Carolina. Laken and Kozel recently launched another DoDPI-funded study designed to mimic as closely as possible the emotions experienced while committing a crime. In the spring, after this research is complete, Laken will start looking for Cephos' first clients – ideally "people who are trying to show that they're being truthful and who want to use our technology to help support their cases."

No Lie MRI will debut its services this July in Philadelphia, where it will demonstrate the technology to be used in a planned network of facilities the company is calling VeraCenters. Each facility will house a scanner connected to a central computer in California. As the client responds to questions using a handheld device, the imaging data will be fed to the computer, which will classify each answer as truthful or deceptive using software developed by Langleben's team. For No Lie MRI founder Joel Huizenga, scanner-based lie detection represents a significant upgrade in "the arms race between truth-tellers and deceivers."

Both Laken and Huizenga play up the potential power of their technologies to exonerate the innocent and downplay the potential for aiding prosecution of the guilty. "What this is really all about is individuals who come forward willingly and pay their own money to declare that

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click fraud

◀141 Splogs are too profitable to be readily discouraged. According to RSS to Blog, a Brooklyn-based firm that sells automatic-blog software, sploggers can earn tens of thousands of dollars a month in PPC income, all without any human effort.

Probably the most worrisome emerging threat is zombie networks – hordes of linked machines controlled by rogue software. Without their owners' knowledge, these boxes continuously send spam, transmit worms and viruses, participate in denial-of-service attacks, and execute a host of other antisocial tasks. These zombie networks can be enormous. In October, Dutch police charged three young men with controlling an incredible 1.5 million computers. In recent months, the owners of zombie networks have begun turning to click fraud – with “very effective” results, according to Tierney, the former click frauder. The robot machines create clicks from all around the world at apparently random intervals, making them difficult to identify.

THE NEW THREAT: ZOMBIE NETS, AND WORMS THAT CLICK EVERY AFFILIATE AD IN THE ENTIRE SYSTEM.

But even if zombie click fraud becomes common, the damage can probably be contained as long as its targets are limited to individual advertisers. As Symantec's Levy points out, PPC firms can always give the victims their month's service free – reducing click fraud to a type of overhead, a cost of doing business. But the impact would be much larger, he notes, if someone decided to attack not single companies but the PPC system itself. “It would not be difficult to construct a worm that would go through the Net, clicking on every Google or Yahoo! affiliate ad that it saw,” Levy says. “If enough of these were loose, you'd swamp the entire system in noise – millions or even billions of extra clicks. It would be very hard to defend against.”

Is this likely to happen? “I would like to be able to say that people aren't that stupid or greedy or aggressive or mindless,” says Chase Law's Butler. “But I can't say any of those things. That is definitely the threat – a threat to the entire system by somebody who is just doing it for the hell of it.”

Type “click fraud” into a search box and you get links to more than 30 million Web sites and ads for the dozens of companies that have sprung up to help victims track the practice. Down the right-hand side of the page march the ad links: Click Defense, Clicklab, Clickrisk, ClickAssurance, VeriClix, Authenticlick, WhosClickingWho. Stoking advertisers' fears by claiming that the system is drowning in click fraud, these outfits nonetheless solicit clients with ... keyword ads on Yahoo! and Google. Indeed, a recent Google search for “click fraud” turned up more than 30 companies. (One outfit, Click Defense, has matched its actions to its words; it sued Google in June, claiming it was getting click-frauded on its “click fraud” keyword ads.)

Most of these firms simply provide ways for advertisers to outsource the tedious task of examining internal logs for fraud. Among those trying to do more is Visitlab, in Santa Cruz, California. According to CEO Vikas Kedia, Visitlab's clients channel incoming clicks through his company, which screens them with software tailored for each cus-

tomers. The software, now in beta, consists of modules that look for telltale behavior – the use of a proxy server, say, or clicks coming from geographic areas that are unlikely to have customers. By amassing data on click behavior and constantly adjusting the software, Kedia believes, it should eventually be possible to detect even a single fraudulent click. “Google could do all this,” he says. “But nobody is sure whether to trust them. We're a third party.”

Bill Gross, the man who invented PPC back in the late '90s when he presided over the startup incubator Idealab, has argued that, despite the cleverness of the various methods used to fight it, click fraud will continue to cast a shadow over PPC advertising. Ultimately, he believes, advertisers will switch to another model, which he calls cost-per-action (others use terms like cost-per-transaction or cost-per-acquisition). Whatever the name, though, advertisers pay only when a click results in a specified action, such as a sale or a Web site registration.

Gross started a CPA search engine, Snap.com, in late 2004. When customers enter the term “airline tickets” on the site, ads for airlines appear. But those airlines don't pay Snap a penny until someone who clicks the ad actually buys a ticket. Even if scammers used zombie networks, the system would ignore them, because it charges only for clicks that lead to an action. Snap, still in beta, is not exactly roaring ahead: According to its own statistics, the firm has 2,300 CPA advertisers. That's roughly 2 percent of Google's or Yahoo!'s advertising base.

Yahoo! is not looking into cost-per-action, Egan says, because such a system requires businesses to share sensitive cost data with their advertising partners. “We start having to ask how much they've sold and what their margins are,” he says. “And if we carry ads for their competitors, we know about them, too. This is not information that businesses like to share with third parties, and for good reason.” For the near future, he says, “I don't believe PPC is going to be supplanted, which is one reason we take click spam” – Yahoo!'s preferred term – “so seriously.”

A possible answer to the privacy worries may be something called Google Wallet. This new initiative, not yet unveiled as of early December, is believed to be a payment scheme that surfers would use, for example, when they bought something after clicking on a Google ad. In theory, at least, Google could process the payment to the advertiser without having to know anything about its costs, profit margins, or other sensitive data. Like Gross's cost-per-action, Google Wallet would be immune to click fraud – zombie machines could click away, and the system would simply ignore them.

Nobody thinks that these measures will eliminate click fraud. Keyword advertising – especially on affiliates – will continue to grow, making it an ever more inviting target to the Net's legion of bad actors. All the while, PPC will continue to be vulnerable to attacks by blackhats who want to disrupt the system as a whole, rather than defraud the individual companies that use it. In consequence, PPC providers seem doomed, at least for the near future, to an endless race against the scammers, spammers, and network jammers. “If you'd told me five years ago that I would be talking about ‘fake clicks,’ I would have told you that you were crazy,” says John Slade, who leads Yahoo!'s click protection efforts. “Now it's all I spend my time on.” ■ ■ ■

◀147 they're telling the truth," Huizenga says. (Neither company has set a price yet.) Still, No Lie MRI plans to market its services to law enforcement and immigration agencies, the military, counterintelligence groups, foreign governments, and even big companies that want to give prospective CEOs the ultimate vetting. "We're really pushing the positive side of this," Huizenga says. "But this is a company – we're here to make money."

Scott Faro, a radiologist at Temple University Hospital who conducted experiments using fMRI in tandem with the polygraph, predicts that the invention of a more accurate lie detector "is going to change the entire judicial system. First it will be used for high-profile crimes like terrorism and Enron. You could have centers across the country built close to airports, staffed with cognitive neuroscientists, MRI physicists, and interrogation experts.

"THIS IS ONE OF THE FEW TECHNOLOGIES TO WHICH THE CLICHÉ 'ORWELLIAN' APPLIES."

Eventually you could have 20 centers in each major city, and the process will start to become more streamlined and cost-effective.

"People say fMRI is expensive," Faro continues, "but what's the cost of a six-month jury trial? And what's the cost to America for missing a terrorist? If this is a more accurate test, I don't see any moral issues at all. People who can afford it and believe they are telling the truth are going to love this test."

The guardians of another Philadelphia innovation that changed the judicial system – the US Constitution – are already sounding the alarm. In September, the *Cornell Law Review* weighed the legal implications of the use of brain imaging in courtrooms and federal detention centers, calling fMRI "one of the few technologies to which the now clichéd moniker of 'Orwellian' legitimately applies."

When lawyers representing Cephos' and No Lie MRI's clients come to court, the first legal obstacles they'll have to overcome are the precedents barring so-called junk science. Polygraph evidence was excluded from most US courtrooms by a 1923 circuit court decision that became known as the Frye test. The ruling set a high bar for the admission of

new types of scientific evidence, requiring that a technology have "general acceptance" and "scientific recognition among physiological and psychological authorities" to be considered. When the polygraph first came before the courts, it had almost no paper trail of independent verification.

fMRI lie detection, however, has evolved in the open, with each new advance subjected to peer review. The Supreme Court has already demonstrated that it is inclined to look favorably on brain imaging: A landmark 2005 decision outlawing the execution of those who commit capital crimes as juveniles was influenced by fMRI studies showing that adolescent brains are wired differently than those of adults. The acceptance of DNA profiling may be another bellwether. Highly controversial when introduced in the 1980s, it had the support of the scientific community and is now widely accepted in the courts.

The introduction of fMRI evidence at trial

may have to be vetted against legal precedents designed to prevent what's called invading the province of the jury, says Carter Snead, former general counsel for the President's Council on Bioethics. In 1973, a federal appeals court ruled that "the jury is the lie detector" and that scientific evidence and expert testimony can be introduced only to help the jury reach a more informed judgment, not to be the final arbiter of truth. "The criminal justice system is not designed simply to ensure accurate truth finding," Snead says. "The human dimension of being subjected to the assessment of your peers has profound social and civic significance. If you supplant that with a biological metric, you're losing something extraordinarily important, even if you gain an incremental value in accuracy."

No Lie MRI's plans to market its services to corporations will likely run afoul of the 1988 Employee Polygraph Protection Act, which bars the use of lie-detection tests by most private companies for personnel screening. Government employers, however, are exempt from this law, which leaves a huge potential market for fMRI in local, state, and federal agencies, as well as in the military.

It is in these sectors that fMRI and other new

lie-detection technologies are likely to take root, as the polygraph did. The legality of fMRI use by government agencies will probably focus on issues of consent, predicts Jim Dempsey, executive director of the Center for Democracy & Technology, a Washington, DC-based think tank. "From a constitutional standpoint, consent covers a lot of sins," he explains. "Most applications of the polygraph in the US have been in consensual circumstances, even if the consent is prompted by a statement like 'If you want this job, you must submit to a polygraph.' The police can say, 'Would you blow into this Breathalyzer? Technically you're free to say no, but if you don't consent, we're going to make life hard for you.'"

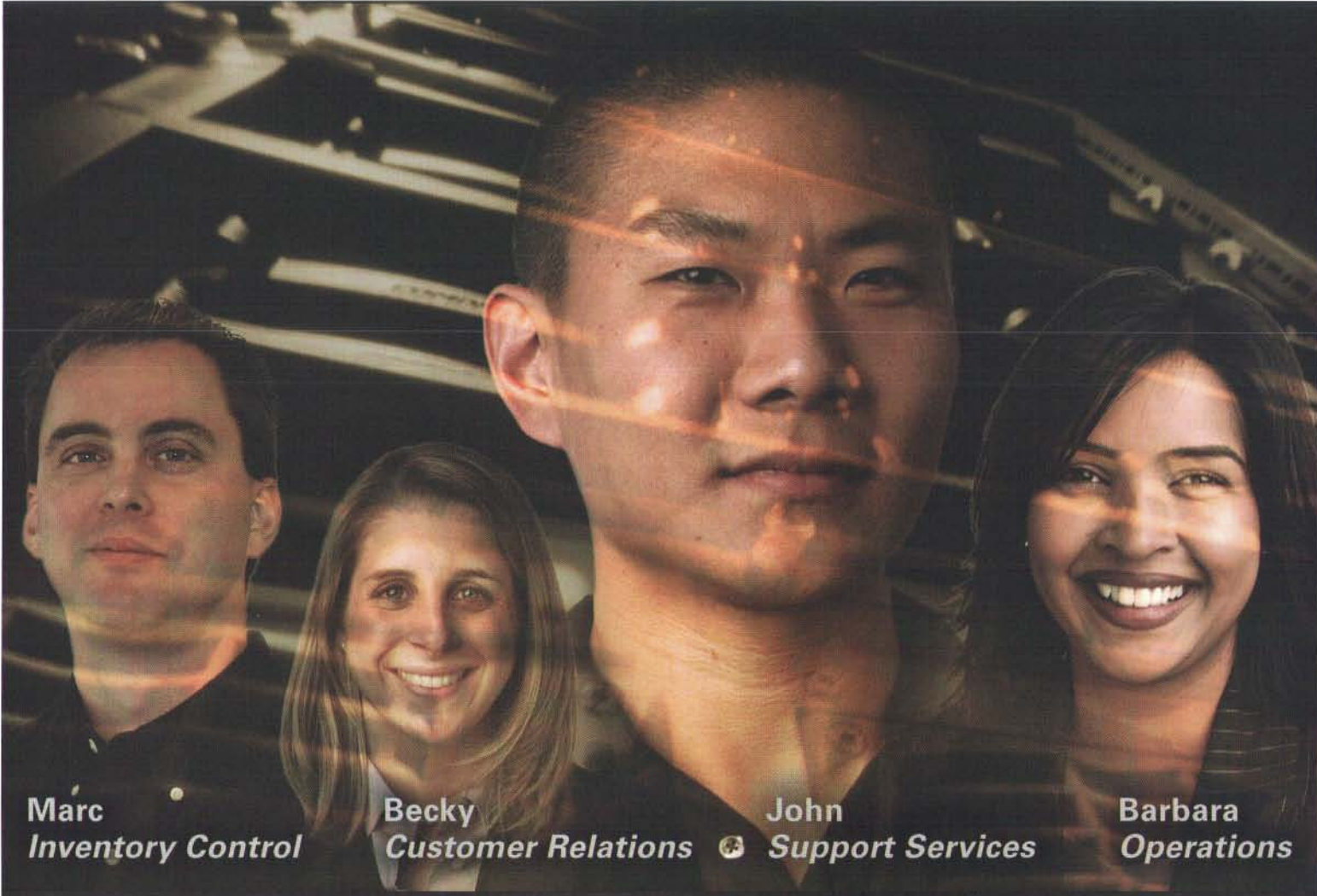
Today's fMRI scanners are bulky, cost up to \$3 million each, and in effect require consent because of their sensitivity to head movement. Once Cephos and No Lie MRI make their technology commercially available, however, these limitations will seem like glitches that merely need to be fixed. If advances make it possible to perform brain scans on unwilling or even unwitting subjects, it will raise a thicket of legal issues regarding privacy, constitutional protections against self-incrimination, and the prohibitions against unlawful search and seizure.

The technological innovations that produce sweeping changes often evolve beyond their designers' original intentions – the Internet, the cloud chamber, a 19th-century doctor's cuff for measuring blood pressure that, when incorporated into the polygraph, became the unsteady foundation of the modern counterintelligence industry.

So what began as a neurological inquiry into why kids with ADHD blurt out embarrassing truths may end up forcing the legal system to define more clearly the inviolable boundaries of the self.

"My concern is precisely with the civil and commercial uses of fMRI lie detection," says ethicist Paul Root Wolpe. "When this technology is available on the market, it will be in places like Guantánamo Bay and Abu Ghraib in a heartbeat.

"Once people begin to think that police can look right into their brains and tell whether they're lying," he adds, "it's going to be 1984 in their minds, and there could be a significant backlash. The goal of detecting deception requires far more public scrutiny than it has had up until now. As a society, we need to have a very serious conversation about this." ■ ■ ■

A photograph of four DataPipe employees. In the center is John, a man of Asian descent, looking directly at the camera. To his left is Becky, a woman with blonde hair, smiling. To his right is Barbara, a woman with dark hair, smiling. On the far left is Marc, a man with dark hair, looking slightly to the side. They are all wearing dark shirts. The background is dark and industrial, with some light reflecting off surfaces.

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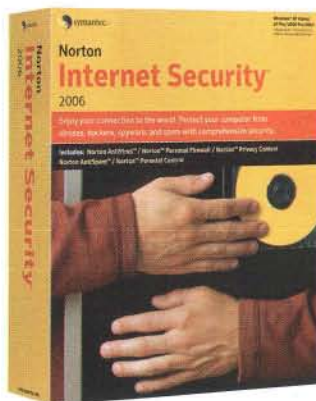


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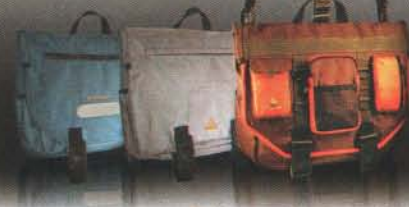


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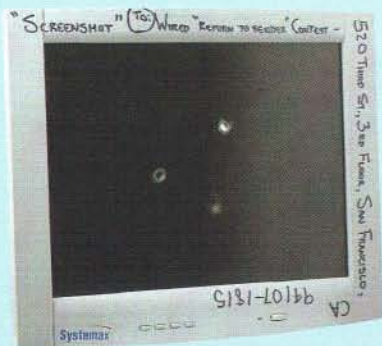
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Self-indulgences that helped get this issue out: the Purple Rain sing-along; consuming alcohol daily while in Europe; consuming alcohol daily while in the Bay Area; getting undressed for Halloween; chocolate-covered macadamia nuts; counting the days before Rent opens; biweekly eel bowls; repeatedly watching Madonna's "Hung Up" video; Pedialyte; the Bliss Basic Facial; the oyster-eating competition in the Wired kitchen; blogging innermost thoughts to an audience of none; a four-bottle dinner at the Underwood; Pitchfork's worst record covers of all time; two new H&Ms; obsessing over the America's Next Top Model fantasy league.

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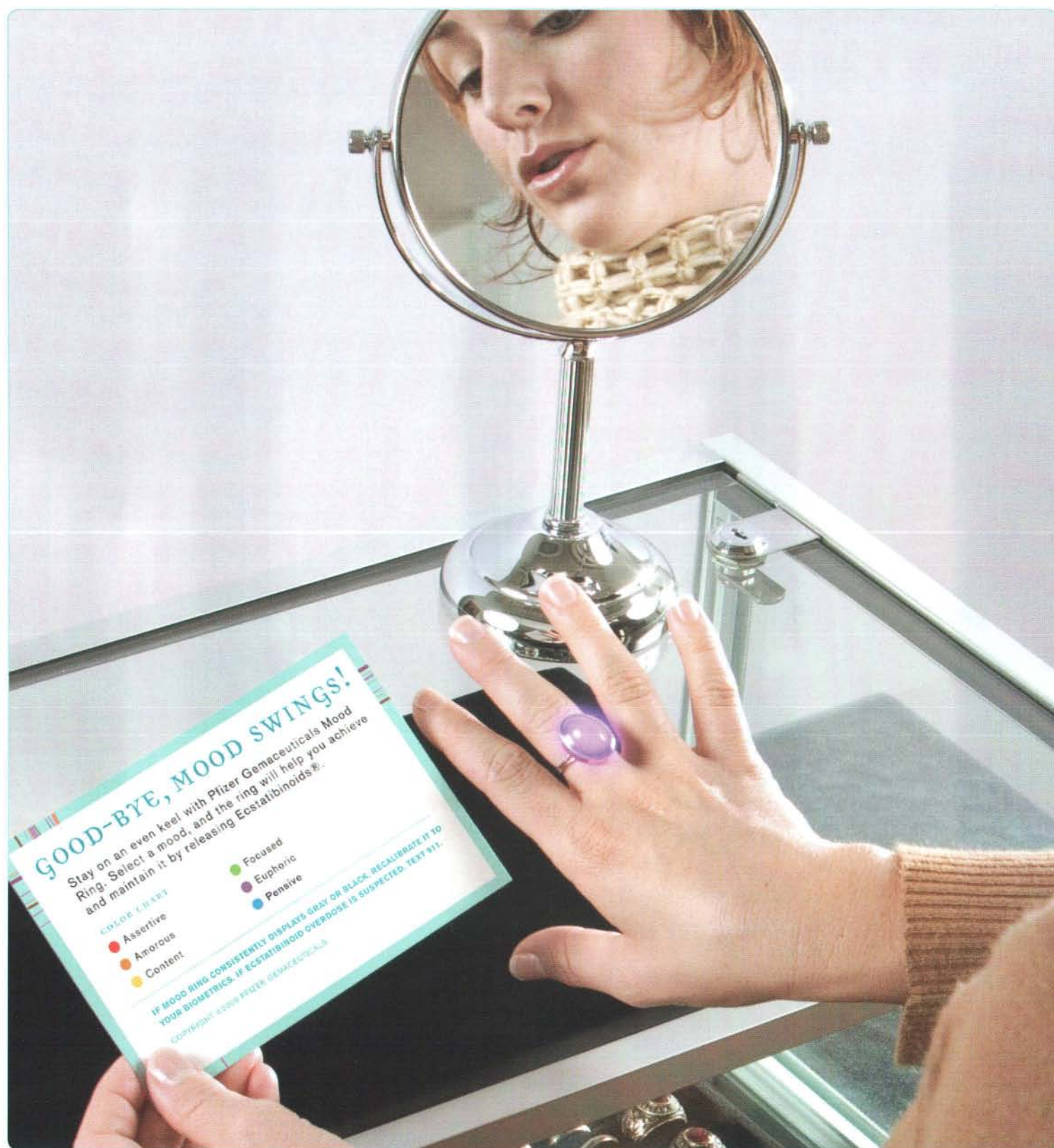
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